the glass industry
VOLUME 37, NUMBER 8, AUGUST, 1956

The Theory and Practice Concerning the Use of Minor Constituents in Glass

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• MINOR CONSTITUENTS HAVE long played a very important role in glass making. Their presence in the glass can help produce a successful melt or lead to a bad melt. The proper selection of materials will aid in fining the glass and in giving it the desired color shade, while other minor constituents, called impurities in this case, can adversely affect fining and color.

As an interesting sidelight, the archeologists are developing techniques to attempt to determine the location where ancient pieces of glassware were made. Tiny fragments of the glass are analyzed spectrographically. By combining the analytical results, particularly with regards to the trace elements, with present day knowledge of the various mineral deposits, it is sometimes possible to determine the origin of the piece of ware.

This paper attempts to bring together some of the more common uses of minor constituents in glassmaking. For this purpose minor constituents are arbitrarily defined as being present in amounts of about 1 per cent or less.

The main topics of discussion are fining, melting aids, durability, solarization, color, and decolorization.

One of the most common uses of minor constituents is that of fining. The usual materials are antimony trioxide, arsenic trioxide, chlorides, sulfates, and iodides.

Antimony and arsenic are effective in fining oxidized glasses. The trioxide is introduced in amounts usually ranging from 0.25 per cent to 1 per cent, depending upon the glass, temperatures used, cullet ratio, and pull. A nitrate as sodium, or potassium, is added to oxidize the material to the pentoxide form, which reverts to the trioxide form at higher temperatures with the liberation of oxygen. Occasionally, in alkali-free glasses, the pentoxide is introduced directly into the batch without the use of nitrates.

The reversion of the pentoxide to the trioxide seems to occur at a higher temperature for arsenic than for antimony. This makes the use of arsenic more practical in the harder, higher melting temperature glasses and antimony in the lower melting, soft glasses. Since batch going through the melting process encounters a large range of temperatures, a mixture of arsenic and antimony is sometimes used to spread out the oxygen evolution over a longer period.

The residual arsenic or antimony can cause blackening of the glass when lamp worked in reducing flames. Also this residue is undesirable in glasses put to certain chemical and pharmaceutical uses.

In some glasses, primarily those borosilicates in which arsenic or antimony may be objectionable, sodium or potassium chlorides are frequently used as fining agents in amounts up to 1.5 per cent. The efficiency of chloride fining depends to some extent on the state of oxidation of the glass. The mechanism of chloride fining is probably a combination of volatilization of the fining agent and hydrolysis to hydrogen chloride. Excessive amounts of chloride in the batch have caused corrosion of iron dampers in the flue system of the glass tank. Chloride-fined glasses also have a tendency to produce a bloom in flame working or sealing operations.

Iodides as sodium or potassium can be used to fine some of the softer glasses. Its mechanism is probably a combination of vaporization of the iodide as such and oxidation to iodine vapor if used in an oxidized glass.

Presented at the Sixteenth Conference on Glass Problems, University of Illinois, Urbana, Illinois, December 1 and 2, 1955.

A group of fining agents commonly used in lime glasses are the sulfates, two of the most common being salt cake or sodium sulfate and barytes or barium sulfate. Sulfates are popular as they are effective and inexpensive. Salt cake is used in amounts of about ½-1 per cent with half of it being retained in the glass. The actual retention is a function of firing conditions, temperatures, and pull. The fining action is probably due to a volatilization of the sodium sulfate and to a decomposition of the sulfate to sulfur dioxide and oxygen.

In a glass tank where various glasses are melted, sulfate fining can cause a serious problem. If a sulfate-fined lime glass is to be followed by a borosilicate type glass, careful washing or flushing is required between the two glasses to prevent high blister losses in the borosilicate glass. This behavior may be caused by a lower solubility of sulfate in the more acid borosilicate glass.

Another group of materials are quite good fining agents although they may not be generally thought of as such. They are some of the coloring materials. Cadmium sulfide when used as a colorant in ruby and yellow glasses is a good fining agent. Cupric oxide and ceric oxide are examples of color materials acting to fine the glass.

Other materials have a very marked influence on fining. Small amounts of fluorine frequently increase the fining rate. Additions of small amounts of boric oxide may also aid fining. Both of these materials decrease the viscosity at high temperatures and thereby enable the seeds to rise more rapidly. Fluorine probably exerts a chemical fining action in addition to making the glass more fluid.

Some of the materials which color the glass can be detrimental to fining. An excessively high iron concentration, introduced possibly by a poor lot of raw material, can cause a seed problem by lowering the bulk temperature of the glass, due to the poorer infrared transmission of the higher iron glass. This effect is the most serious when the tank is melting at high load and is on the ragged edge of acceptable seed quality.

Some of the minor constituents are valuable in aiding the melting of glass and in getting more glass from a tank. As mentioned before, both boric oxide and fluorine aid fining and reduce the high temperature viscosity. Sand solution rates, or fluxing, also are improved especially in the case of fluorine. Lithia is probably the most potent flux of the alkalies on a weight percentage basis, making it possible to speed sand solution by a small addition. Barium oxide also has a beneficial effect on the melting of some glasses, especially lime glasses.

Some of these materials also have drawbacks in practice. Lithia is expensive especially when added as the carbonate. Boric oxide most economically added as one of the borax compounds, is somewhat expensive and has a tendency to increase slagging in regenerators. Glass containing even small amounts of fluorine has a tendency to fume more than fluorine-free glasses. Mold and plunger equipment on presses therefore becomes dirty more quickly and requires more frequent cleaning.

Titania also will reduce the high temperature viscosity and act as a flux.

The chemical durability of lime glasses can frequently be improved by additions of ½-1 per cent boric oxide enabling bulbs and tubing to better withstand storage in humid warehouses. Alumina will also increase the chemical durability, although the amounts frequently used may run up to several per cent. While it does not represent a direct addition to the glass batch, sulfur dioxide vapor treatment of bulbs or other ware increases durability.

A problem frequently arising from the use of glass in sunlight or near mercury vapor and fluorescent lamps is that of solarization. The resulting color changes vary with the impurities in the glass and the decolorizers used, if any. In many cases this color change can be lessened by the introduction of titania, antimony, or lead. Apparently these materials increase resistance to solarization by preventing shorter ultraviolet radiation from penetrating deeply into the glass and changing the oxidation-reduction state of the various impurities. Prevention of a drop in transmission in glasses used for germicidal lamps and ozone-producing lamps is a different problem. The use of the materials previously mentioned, lead, titania, and antimony, is prohibited because they themselves absorb the desired very short wavelength ultraviolet. Strictly speaking, this drop in transmission cannot be called solarization because the wavelengths involved (in the 1850-2500° Å region) are not present in the sunlight reaching the Earth.

Another of the most common uses to which minor constituents are put in glassmaking are the colors. Much has been written about both the use of coloring materials and the theory behind them. This paper includes only some of the more commonly used of the colors. It is rather difficult to generalize about some of the color materials because of the influence of the base glass upon the color produced.

Cobalt oxide is frequently used for blue glasses. The color given by cobalt is often modified by other colors to produce the required shade. Cobalt usually produces a blue-purple color. Transmission curves of typical cobalt glasses show both the blue and longer wavelength red sections of the visible spectrum are transmitted while green-through-orange wavelengths are absorbed.

The cobalt color may be modified by adding other coloring materials. Copper oxide, added in the oxidized form and maintained thus, will absorb much of the red. This type color combination is frequently used in the so-called daylight blue glasses and in blue-green glasses.

Nickel oxide when added to a cobalt blue glass will extend the absorption range further toward the flue part of the spectrum. Thus, by the use of cobalt and nickel in the proper proportions, it is possible to produce gray glasses. Although nickel absorbs in the blue-green, it transmits well in the near ultraviolet. Glasses can, therefore, be made by using cobalt and nickel at higher concentrations than just mentioned to absorb visible light and appear black and still transmit near ultraviolet.

Nickel oxide when used alone yields violet colors in potash glasses and brownish colors in glasses containing only soda.

Copper oxide, as implied above, will produce a blue-green glass in the oxidized state. By using cuprous oxide in reduced glasses, a ruby color can be produced by heat treatment.

Chromium oxide is a common colorant used in green

(*Continued on page* 463)

Acid-Base Relationship in Glass Systems

APPLICATION OF THE OXYGEN ELECTRODE IN GALVANIC CELLS WITH GLASSES OF DIFFERENT COMPOSITION

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ABSTRACT

Cells are prepared which use two glasses of different composition as the electrolyte in contact with silver electrodes in an atmosphere of oxygen. The cell mechanism is reviewed as presented by Tashiro and Forland in the second paper of this series where it was shown that the E. M. F. developed by such a cell can be taken as a measure of the relative basicity or acidity of the two glasses.

Simple alkali trisilicate glass is used as a reference glass in contact with a similar glass into which SiO_2, MgO or BaO is substituted for an equivalent amount of the alkali. The acidity relationships within an alkali silicate system are determined for the lithium, sodium and potassium silicates containing varying amounts of SiO_2, MgO and BaO.

It was found that the alkaline earth oxides bring about a greater increase in acidity than an equivalent amount of SiO_2. An explanation in terms of the field strength and coordination number of the ions introduced is offered.

I. INTRODUCTION

This paper is concerned with the application of the oxygen electrode, as described in the second paper of this series by Tashiro and Forland[1], to the study of the relative acidities of glasses of different composition. While the electrical properties of glass have been well studied, and a number of investigators have used glass as the electrolyte in galvanic cells [2] [3], only a few have studied such cells from the standpoint of the oxygen electrode [4] [5]. Since the oxygen electrode provides information concerning the relative acidities of glasses, a means is thus provided for obtaining information which may lead to a better understanding of the effect of chemical composition on some of the known properties of glass.

The cell reaction was described as the sum of the oxygen electrode reactions plus the transport of the alkali ions from Glass I to Glass II. This may be expressed as

$$(Na_2O)_I \longrightarrow (Na_2O)_{II}$$

which indicates the change of the alkali oxide from one activity to another. Since the activity of the alkali oxide may be used as a quantitative measure of basicity, the potential developed by the cell may now be used to measure the relative basicity or, conversely, the relative acidity of one glass with respect to another. Since the glass technologist is more familiar with the concept of acidity as applied to glass, this term is used throughout this paper.

In this investigation glasses were studied of the type $(1\text{-}x)R_2O \cdot xRO \cdot 3SiO_2$ and $(1\text{-}x)R_2O \cdot (3+x)SiO_2$ in which R_2O is Li_2O, Na_2O, or K_2O, and RO is MgO or BaO. The purpose of the experiments was to determine how additions of MgO, BaO or SiO_2 added to a particular base glass changes the acidity of the glass.

II. EXPERIMENTAL PROCEDURE

The technique for preparing the cells from glass rods and silver foil was the same as described by Forland and Tashiro[1]. The accuracy of the potential measuring circuit was increased from ±5 millivolts to ±1 millivolt through the use of a more accurate null detector (RCA Voltohmyst, Type WV-87A). In addition, the measurements were frequently checked using a Beckman pH meter (Model H2) calibrated to read with an accuracy of ±2 millivolts.

The manner in which the cells were heated was modified. Tashiro heated his cells to the highest temperature at which E. M. F. measurements were taken and maintained the cell at this temperature for about one hour in order to be certain that the potential reached an equi-

The third and final paper in the series of three, dealing with the acid-base relationship in glass systems.

Mineral Industries Contribution No. 55-65, The Pennsylvania State University, University Park, Pennsylvania.

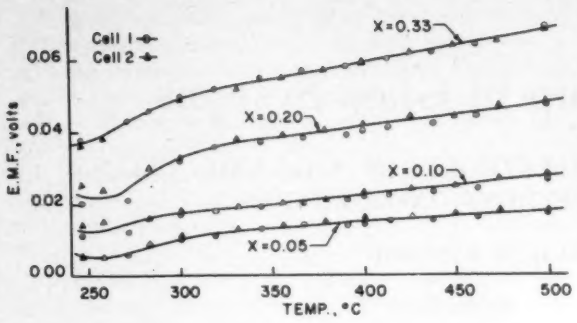

Fig. 1. E. M. F. developed by the cell $Ag/Na_2O{\cdot}3SiO_2//(1-x)Na_2O{\cdot}(3+x)SiO_2/Ag$.

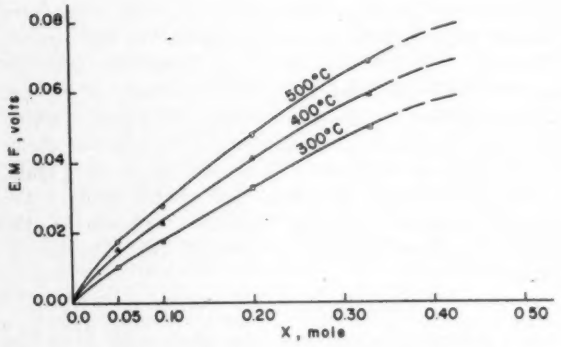

Fig. 2. E. M. F. developed by the cell $Ag/Na_2O{\cdot}3SiO_2//(1-x)Na_2O{\cdot}(3+x)SiO_2/Ag$.

librium (stable) value. Further measurements at lower temperatures were taken at about 100°C intervals after the cell had been held at each specific temperature for an hour. In the present study a re-examination of the time required for the E. M. F. to become stable at any particular temperature showed that an equilibrium value was obtained almost instantaneously. Consequently, the cells were cooled continuously after having been initially maintained at the highest temperature (500°C.) for an hour. The E. M. F. values were then recorded at 10°-15° intervals as the cell cooled at a rate of 5° per minute until 250°C. was reached. At least two cells of each composition were measured.

III. EXPERIMENTAL RESULTS

a. Sodium Silicate Systems

The molecular compositions and mol percentages of glasses studied in the sodium silicate system are given in Table I. The first section of Table I gives the compositions of glasses in which SiO_2 was increased at the expense of Na_2O according to the general formula $(1-x)Na_2O{\cdot}(3+x)SiO_2$ where $x = 0.05$ to 0.33. The potentials developed in cells containing these glasses in contact with the base glass, $Na_2O{\cdot}3SiO_2$, are plotted as a function of temperature in Figure 1. As the temperature increases from 250°C. to 500°C. the potential increases from 0.005 to 0.018 volt for the first substitution of SiO_2 (0.05 mol) and from 0.038 to 0.069 volt for the 0.33 mol SiO_2 substitutions. The increase in E. M. F. with increasing SiO_2 for three specific temperatures is shown in Figure 2. For example, at 500°C. the potential is 0.017 volt for the composition $0.95Na_2O{\cdot}3.05SiO_2$ and 0.68 volt for the composition $0.67Na_2O{\cdot}3.33SiO_2$. It is noteworthy that the polarity of the cells for this system and for all the following systems was such that the electrode in contact with the base glass was always negative.

TABLE I

Sodium Silicate Glass Compositions

Molecular Compositions	Mol Per Cent Na_2O	SiO_2	MgO	BaO
$Na_2O{\cdot}3SiO_2$ (Base Glass)	25.00	75.00		
$(1-x)\ Na_2O{\cdot}(3+x)SiO_2$				
$0.95Na_2O{\cdot}3.05SiO_2$	23.75	76.25		
$0.90Na_2O{\cdot}3.10SiO_2$	22.50	77.50		
$0.80Na_2O{\cdot}3.20SiO_2$	20.00	80.00		
$0.67Na_2O{\cdot}3.33SiO_2$	16.75	83.25		
$(1-x)\ Na_2O{\cdot}xMgO{\cdot}3SiO_2$				
$0.95Na_2O{\cdot}0.05MgO{\cdot}3SiO_2$	23.75	75.00	1.25	
$0.90Na_2O{\cdot}0.10MgO{\cdot}3SiO_2$	22.50	75.00	2.50	
$0.80Na_2O{\cdot}0.20MgO{\cdot}3SiO_2$	20.00	75.00	5.00	
$0.67Na_2O{\cdot}0.33MgO{\cdot}3SiO_2$	16.75	75.00	8.25	
$0.50Na_2O{\cdot}0.50MgO{\cdot}3SiO_2$	12.50	75.00	12.50	
$(1-x)\ Na_2O{\cdot}xBaO{\cdot}3SiO_2$				
$0.95Na_2O{\cdot}0.05BaO{\cdot}3SiO_2$	23.75	75.00		1.25
$0.90Na_2O{\cdot}0.10BaO{\cdot}3SiO_2$	22.50	75.00		2.50
$0.80Na_2O{\cdot}0.20BaO{\cdot}3SiO_2$	20.00	75.00		5.00
$0.67Na_2O{\cdot}0.33BaO{\cdot}3SiO_2$	16.75	75.00		8.25
$0.50Na_2O{\cdot}0.50BaO{\cdot}3SiO_2$	12.50	75.00		12.50

TABLE II

Potassium Silicate Glass Compositions

Molecular Compositions	Mol Per Cent K_2O	SiO_2	MgO	BaO
$K_2O{\cdot}3SiO_2$ (Base Glass)	25.00	75.00		
$(1-x)K_2O{\cdot}(3+x)SiO_2$				
$0.95K_2O{\cdot}3.05SiO_2$	23.75	76.25		
$0.90K_2O{\cdot}3.10SiO_2$	22.50	77.50		
$0.80K_2O{\cdot}3.20SiO_2$	20.00	80.00		
$0.67K_2O{\cdot}3.33SiO_2$	16.75	83.25		
$(1-x)K_2O{\cdot}xMgO{\cdot}3SiO_2$				
$0.95K_2O{\cdot}0.05MgO{\cdot}3SiO_2$	23.75	75.00	1.25	
$0.90K_2O{\cdot}0.10MgO{\cdot}3SiO_2$	22.50	75.00	2.50	
$0.80K_2O{\cdot}0.20MgO{\cdot}3SiO_2$	20.00	75.00	5.00	
$0.67K_2O{\cdot}0.33MgO{\cdot}3SiO_2$	16.75	75.00	8.25	
$0.50K_2O{\cdot}0.50MgO{\cdot}3SiO_2$	12.50	75.00	12.50	
$(1-x)K_2O{\cdot}xBaO{\cdot}3SiO_2$				
$0.95K_2O{\cdot}0.05BaO{\cdot}3SiO_2$	23.75	75.00		1.25
$0.90K_2O{\cdot}0.10BaO{\cdot}3SiO_2$	22.50	75.00		2.50
$0.80K_2O{\cdot}0.20BaO{\cdot}3SiO_2$	20.00	75.00		5.00
$0.67K_2O{\cdot}0.33BaO{\cdot}3SiO_2$	16.75	75.00		8.25
$0.50K_2O{\cdot}0.50BaO{\cdot}3SiO_2$	12.50	75.00		12.50

The alkaline earth oxides MgO and BaO were introduced at the expense of the sodium oxide in glasses of the general type $(1-x)Na_2O{\cdot}xRO{\cdot}3SiO_2$ where x varied from 0.05 to 0.50 (Table I). These glasses in contact with the base glass, $Na_2O{\cdot}3SiO_2$, develop potentials which increase as the Na_2O is replaced by MgO (Fig. 3) or BaO (Fig. 4). For example, when 0.05 mol of MgO replaces an equivalent amount of Na_2O, the potential at 500°C. is 0.014 volt whereas a 0.50 mol replacement gives a potential of 0.130 volt. In the case of BaO, the potentials at 500°C. are 0.017 volt and 0.112 volt for BaO concentrations of 0.05 and 0.50 mol respectively. For each cell the E. M. F. increases with temperature.

A comparison is given in Figure 5 of the potentials obtained at 500°C. for the cells in which the various glasses were placed in contact with the base glass, $Na_2O{\cdot}3SiO_2$. At this temperature, as for all temperatures measured, the potential is highest for MgO, intermediate for BaO and lowest for SiO_2 when each is substituted for Na_2O.

In terms of acidity this is interpreted on the basis that MgO substituted for Na_2O produces more acid glasses than equivalent substitutions of BaO. BaO glasses, in turn, are more acid than glasses with equivalent SiO_2 substitutions.

b. Potassium Silicate System

The molecular compositions and mol percentages of glasses studied in this system are given in Table II.

When glasses of the compositions $(1-x)K_2O{\cdot}(3+x)SiO_2$ are placed in contact with the base glass, $K_2O{\cdot}3SiO_2$, potentials are obtained which increase as x is varied from 0.05 to 0.33 mol (Fig. 6). For example, the E. M. F. at 500°C. is 0.022 volt when 0.05 mol K_2O is replaced by SiO_2 and 0.110 volt when 0.33 mol is replaced.

Magnesium oxide and barium oxide were systematically introduced into the base glass, $K_2O{\cdot}3SiO_2$, by substituting for K_2O according to the formula $(1-x){\cdot}K_2O{\cdot}xRO{\cdot}3SiO_2$ where x = 0.05 to 0.50 mol as given in Table II. The MgO glasses in contact with the $K_2O{\cdot}3SiO_2$ glass give potentials at 500°C. which vary from 0.013 volt to 0.191 volt as the K_2O is replaced by MgO over the range 0.05 to 0.50 mol (Fig. 7). In the case of the BaO glasses at 500°C. the potentials vary from 0.23 volt to 0.164 volt over the range of BaO introduced as shown in Figure 8.

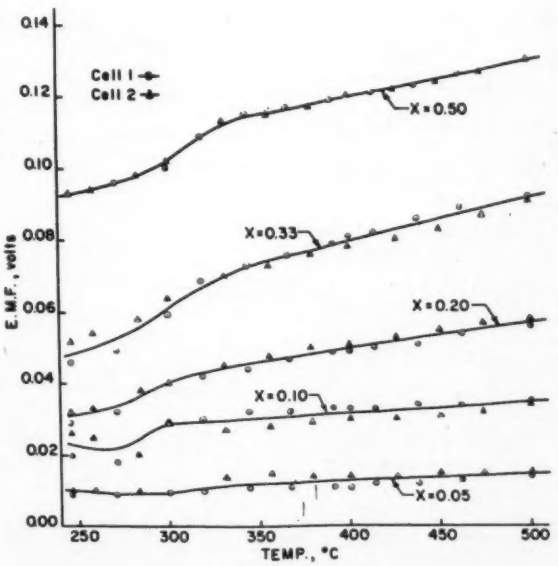

Fig. 3. E. M. F. developed by the cell $Ag/Na_2O{\cdot}3SiO_2//(1-x)Na_2O{\cdot}xMgO{\cdot}3SiO_2/Ag$.

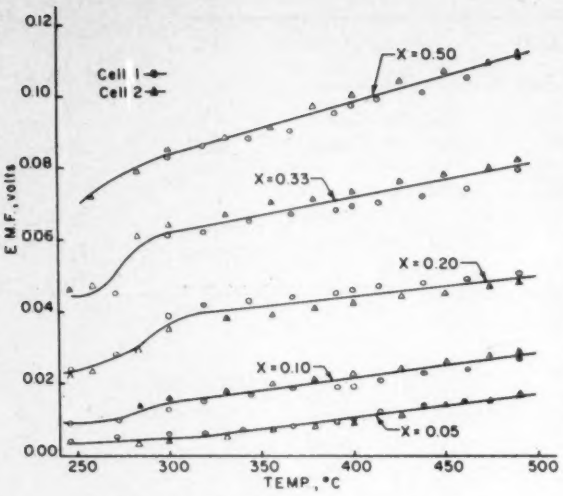

Fig. 4. E. M. F. developed by the cell $Ag/Na_2O{\cdot}3SiO_2//(1-x)Na_2O{\cdot}xBaO{\cdot}3SiO_2/Ag$.

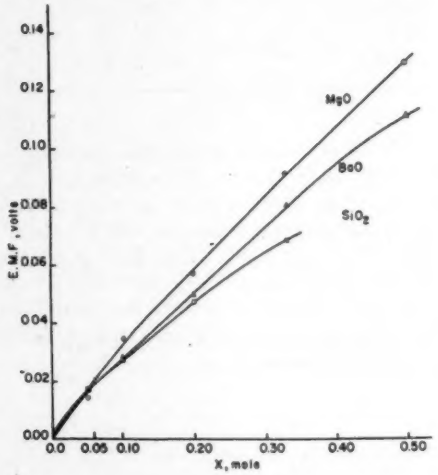

Fig. 5. E. M. F. vs x moles of MgO, BaO or SiO_2 substituted for Na_2O in $Na_2O{\cdot}3SiO_2$ at 500°C.

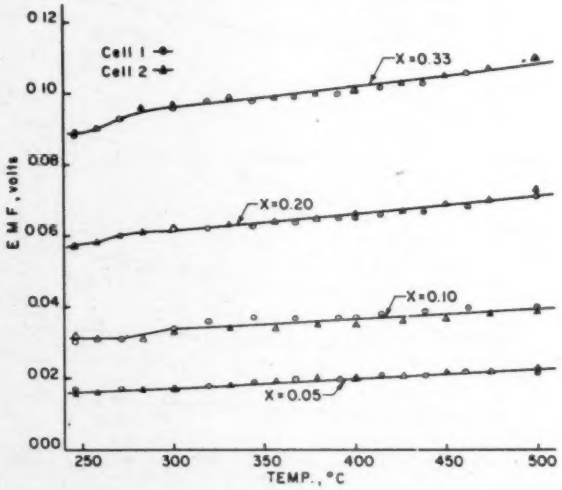

Fig. 6. E. M. F. developed by the cell $Ag/K_2O{\cdot}3SiO_2//(1-x)K_2O{\cdot}(3+x)SiO_2/Ag$.

A comparison is given in Figure 9 of the potentials obtained at 500°C for the cells in which the various glasses were placed in contact with the base glass, $K_2O{\cdot}3SiO_2$. At this temperature and for MgO, BaO and SiO_2 substitutions exceeding 0.30 mol, the potential is highest for MgO, intermediate for BaO and lowest for SiO_2 when each is substituted for K_2O. At lower concentrations this relationship does not exist. Below a 0.30 mol substitution the potential developed by the MgO glass is lower than that of the corresponding BaO glass. At still lower concentrations, below 0.17 mol substitution, the potential of the MgO-containing glass is even less than that of the glass in which SiO_2 is substituted for K_2O. At lower temperatures, essentially the same relationship in potentials exists for the MgO, BaO and SiO_2 substitutions except that the points of intersection are shifted to slightly lower concentrations.

On the basis of the interpretation of the potentials as a measure of the relative acidities of the glasses, this would indicate that the MgO glass is more acid than the BaO glass at concentrations above 0.30 mol and less acid below 0.30 mol. The BaO glasses are more acid than those containing equivalent substitutions of SiO_2 for K_2O. MgO, on the other hand, increases the acidity more than equivalent SiO_2 substitutions above 0.17 mol. Below 0.17 mol the SiO_2 substitutions produce the more acid glasses.

c. Lithium Silicate System

This system was treated in the same manner as the sodium and potassium systems. The molecular compositions and mol percentages are given for these glasses in Table III (see page 442).

Silica additions were made at the expense of the Li_2O according to the formula $(1-x)Li_2O{\cdot}(3+x)SiO_2$ where x varied from 0.05 to 0.20 mol. It was not possible to

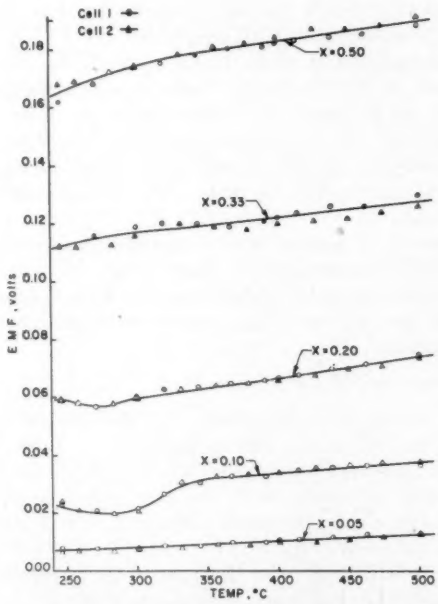

Fig. 7. E. M. F. developed by the cell $Ag/K_2O{\cdot}3SiO_2//(1-x)K_2O{\cdot}xMgO{\cdot}3SiO_2/Ag$.

make glasses where the substitution exceeded 0.20 mol because devitrification occurred. Cells prepared from these glasses develop potentials at 500°C. which range from 0.010 to 0.027 volt when 0.05 to 0.20 mol Li_2O is replaced by SiO_2 (Fig. 10). There is very little variation in the E. M. F. with temperature.

Magnesium oxide and barium oxide substitutions were made to the base glass according to the previously used scheme, $(1-x)Li_2O{\cdot}xRO{\cdot}3SiO_2$. Owing to the strong tendency toward devitrification in MgO glasses, it was not possible to exceed a 0.20 mol MgO concentration. However, the BaO substitution ranged from 0.05 to 0.33 mol. The substitution of MgO for Li_2O gives higher potentials than corresponding SiO_2 substitutions. Figure 11 shows that the 0.05 mol MgO substitution gives a potential at 500°C. of 0.024 volt while with 0.20 mol MgO, 0.057 volt is obtained. As in the previous case, the E. M. F. increases with temperature. The potentials developed by cells composed of the lithium-barium-silicate glass in contact with the base glass, $Li_2O{\cdot}3SiO_2$ are shown in Figure 12. The potentials are slightly higher than those of the MgO glasses. At 500°C. the potentials are 0.37 volt for 0.05 mol BaO and 0.097 volt for 0.33 mol BaO.

In Figure 13 a comparison is made of the potentials developed at 500°C. by the glasses containing BaO, MgO and SiO_2 in contact with the base glass, $Li_2O{\cdot}3SiO_2$. At this temperature the potentials decrease in the order BaO > MgO > SiO_2 when substituted for Li_2O. This means that BaO is more effective in increasing the acidity of this base glass than MgO which, in turn, is more effective than SiO_2 when subsituted for equivalent amounts of Li_2O.

d. Cells Consisting of Glasses Containing Magnesium and Barium

During the course of this investigation the relative acidities of various silicate glasses have been established by comparing the potentials obtained for cells consisting of a reference glass and glasses containing BaO, MgO or SiO_2 subsituted for an alkali oxide. The reference glass in each case consists of the respective alkali silicate.

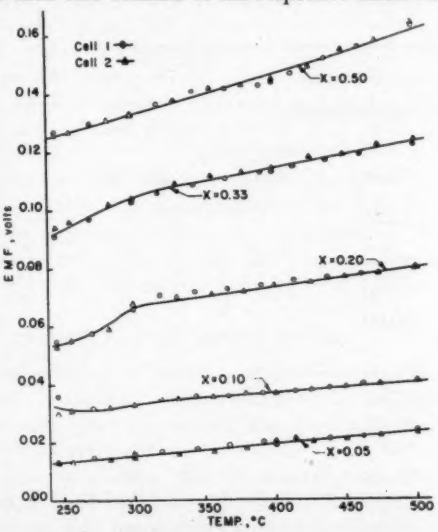

Fig. 8. E. M. F. developed by the cell $Ag/K_2O{\cdot}3SiO_2//(1-x)K_2O{\cdot}xBaO{\cdot}3SiO_2/Ag$.

It was shown in the sodium silicate system, for example, that substitutions of MgO for Na_2O produce more acid glasses (higher potential) than equivalent susbstitutions of BaO (lower potential). A similar relationship is observed in the potassium silicate system with RO concentrations above 0.3 mol. Below 0.3 mol, however, the BaO glass is more acid (higher potential) than the MgO glass (lower potential).

It has been assumed that the potentials of cells consisting of a MgO glass and a reference glass can be compared with those of a BaO glass and the same reference glass in order to establish the acidity relationship between the MgO and BaO glasses. If this is true, then the same relationship should be found by measuring the potentials

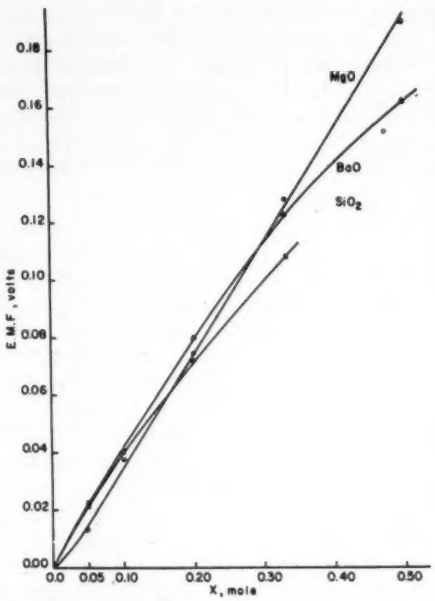

Fig. 9. E. M. F. vs x moles of MgO, BaO or SiO_2 substituted for K_2O in $K_2O{\cdot}3SiO_2$ at 500°C.

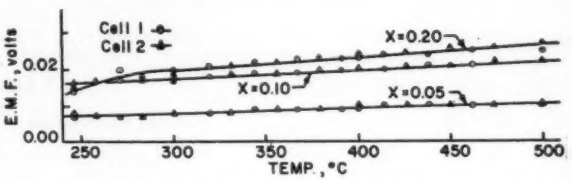

Fig. 10. E. M. F. developed by the cell $Ag/Li_2O{\cdot}3SiO_2//(1-x)Li_2O{\cdot}(3+x)SiO_2/Ag$.

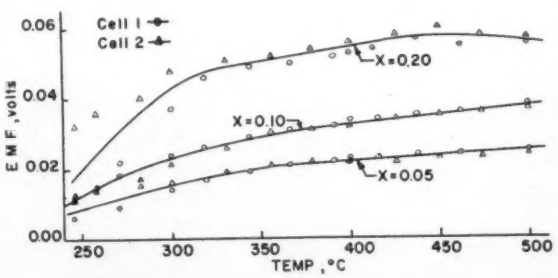

Fig. 11. E. M. F. developed by the cell $Ag/Li_2O{\cdot}3SiO_2//(1-x)Li_2O{\cdot}xMgO{\cdot}3SiO_2/Ag$.

of cells consisting of both the MgO glass and the BaO glass such as:

$$Ag \;/\; (1-x)\; R_2O{\cdot}xMgO{\cdot}3SiO_2 \;//\; (1-x)R_2O{\cdot}xBaO{\cdot}3SiO_2 \;/\; Ag$$

This assumption was verified by the following experiments:

Two cells in the sodium silicate system were studied. These cells can be represented as:

Cell I: $Ag/0.80Na_2O{\cdot}\textit{0.20MgO}{\cdot}3SiO_2//\ 0.80Na_2O{\cdot}\textit{0.20BaO}{\cdot}3SiO_2/Ag$

Cell II: $Ag/0.67Na_2O{\cdot}\textit{0.33MgO}{\cdot}3SiO_2//\ 0.67Na_2O{\cdot}\textit{0.33BaO}{\cdot}3SiO_2/Ag$

The polarity of these cells was such that the electrode in contact with the glass containing MgO was positive indicating that the MgO glass is more acid than the BaO glass. This verifies the acidity relationship obtained indirectly by separate comparison of the MgO and BaO glasses with the base glass, $Na_2O{\cdot}3SiO_2$ (Fig. 5). Cell I develops an E. M. F. of 0.008 volt at 250°C. which increases slightly to 0.010 volt at 500°. Cell II develops an E. M. F. of 0.018 volt at 250°C. which increases to 0.020 volt at 500°C.

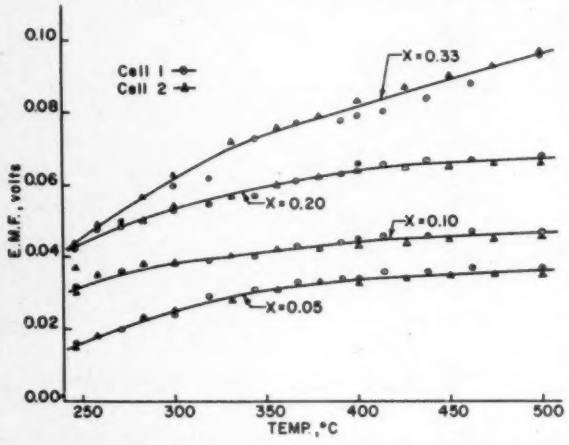

Fig. 12. E. M. F. developed by the cell $Ag/Li_2O{\cdot}3SiO_2//(1-x)Li_2O{\cdot}xBaO{\cdot}3SiO_2/Ag$.

In the potassium silicate system four cells were measured:

Cell I: $Ag/0.90K_2O{\cdot}0.10MgO{\cdot}3SiO_2//\ 0.90K_2O{\cdot}0.10BaO{\cdot}3SiO_2/Ag$

Cell II: $Ag/0.80K_2O{\cdot}0.20MgO{\cdot}3SiO_2//\ 0.80K_2O{\cdot}0.20BaO{\cdot}3SiO_2/Ag$

Cell III: $Ag/0.67K_2O{\cdot}0.33MgO{\cdot}3SiO_2//\ 0.67K_2O{\cdot}0.33BaO{\cdot}3SiO_2/Ag$

Cell IV: $Ag/0.50K_2O{\cdot}0.50MgO{\cdot}3SiO_2//\ 0.50K_2O{\cdot}0.50BaO{\cdot}3SiO_2/Ag$

Figure 14 shows the potentials developed by these cells at 500°C. The E.M.F. values are plotted choosing the potential of the electrode in contact with the Ba-containing glass as zero. At low concentrations of alkaline earth oxide (0.10 and 0.20 mol) the electrode in contact with the Mg-containing glass is negative, above 0.30 mol it is positive. This indicates that MgO is more acid than the BaO glass in the concentration range above 0.30 mol but less acid below this concentration. This agrees with the acidity relationship obtained indirectly by separate comparison of the BaO and MgO glasses with the base glass, $K_2O{\cdot}3SiO_2$ (Fig. 9).

IV. DISCUSSION

It was shown in a previous paper of this series[6] that the acidity of a silicate glass may be taken as a measure of the state of polarization of the oxygen ions in the glass structure. On the same basis an acid oxide is defined as having oxygen ions which are strongly polarized, whereas in basic oxides the oxygen is less polarized. Therefore, cations which possess high ionic potentials will form what may be termed acidic oxides. An example of an acidic glass-forming oxide is SiO_2. Cations such as the alkali ions which are weakly bound to the oxygen ions form basic oxides.

a. The Cell Reaction

The following discussion of the cell mechanism and the role played by the current-carrying alkali ions will

TABLE III

Lithium Silicate Glass Compositions

Molecular Compositions	Mol Per Cent Li_2O	SiO_2	MgO	BaO
$Li_2O{\cdot}3SiO_2$ (Base Glass)	25.00	75.00		
$(1-x)Li_2O{\cdot}(3+x)SiO_2$				
$0.95Li_2O{\cdot}3.05SiO_2$	23.75	76.25		
$0.90Li_2O{\cdot}3.10SiO_2$	22.50	77.50		
$0.80Li_2O{\cdot}3.20SiO_2$	20.00	80.00		
$(1-x)Li_2O{\cdot}xMgO{\cdot}3SiO_2$				
$0.95Li_2O{\cdot}0.05MgO{\cdot}3SiO_2$	23.75	75.00	1.25	
$0.90Li_2O{\cdot}0.10MgO{\cdot}3SiO_2$	22.50	75.00	2.50	
$0.80Li_2O{\cdot}0.20MgO{\cdot}3SiO_2$	20.00	75.00	5.00	
$(1-x)Li_2O{\cdot}xBaO{\cdot}3SiO_2$				
$0.95Li_2O{\cdot}0.05BaO{\cdot}3SiO_2$	23.75	75.00		1.25
$0.90Li_2O{\cdot}0.10BaO{\cdot}3SiO_2$	22.50	75.00		2.50
$0.80Li_2O{\cdot}0.20BaO{\cdot}3SiO_2$	20.00	75.00		5.00
$0.67Li_2O{\cdot}0.33BaO{\cdot}3SiO_2$	16.75	75.00		8.25

aid in interpreting the relationship between the potentials and the acidities of the glasses investigated. The cell used in this investigation may be represented as follows:

$$\text{Ag / Glass I // Glass II / Ag.}$$

The first step involves the dissolution of the silver electrodes forming silver ions in the glasses. Utilizing the oxygen in the air, the previously indicated cell may now be more accurately described as follows:

$$O_2\,(Ag) \,/\, (Ag_2O)\ \text{Glass I // Glass II}\ (Ag_2O) \,/\, (Ag)\ O_2.$$

In the temperature range studied, 250°-500°C., the alkali ions are responsible for carrying the current across the cell. In passing a positive current from the left to the right, the following reaction takes place at the left electrode:

$$2\,Ag^{\circ} = 2\,Ag^{+} + 2\,e^{-}. \qquad (1)$$

In addition there is an equilibrium given by the equation:

$$2\,Ag^{+} + O^{2-} = 2\,Ag^{\circ} + \tfrac{1}{2}\,O_2. \qquad (2)$$

The sum of these two equations may be expressed as

$$O^{2-}{}_{(I)} = \tfrac{1}{2}\,O_2 + 2\,e^{-}. \qquad (3)$$

Likewise the electrode reaction at the right will be similar but in the opposite direction, that is

$$\tfrac{1}{2}\,O_2 + 2\,e^{-} = O^{2-}{}_{(II)}. \qquad (4)$$

The sum of reactions (3) and (4) plus the transport of the alkali ions from Glass I to Glass II ($Na^{+}{}_{(I)} \rightarrow Na^{+}{}_{(II)}$) now gives the complete cell reaction. This may be expressed as

$$(Na_2O)_I \rightarrow (Na_2O)_{II} \qquad (5)$$

which indicates the change of alkali oxide from one activity to another. The electromotive force E of the cell may now be expressed according to the equation:

$$E = -\frac{RT}{2F} \ln \frac{a_{Na_2O_{(II)}}}{a_{Na_2O_{(I)}}} \qquad (6)$$

assuming the junction potential between glasses to be negligible. Thus, the electromotive force of the cell is a measure of the work required for transferring Na_2O from one glass to another. Since the activity of the alkali oxide in a glass may be used as a quantitative measure of the basicity, the potential developed by the cell may now be used to measure the relative basicity or, conversely, the relative acidity of one glass with respect to another.

In agreement with equation 6 the polarity of the cells must be such that the electrode in contact with the more acid glass is positive. This means, of course, that the direction of migration of the alkali ions in the cell is always from the less acid to the more acid glass.

b. Interpretation of Experimental Results

The substitution of alkaline earth oxides such as MgO and BaO for the alkali causes the acidity of the glass to increase more than equimolar SiO_2 substitutions. These relationships are indicated in Figures 5, 9, and 13 for the sodium, potassium, and lithium silicate systems respectively. It should be emphasized that the term "substitution" as used here applies only to the changes within the glass composition formula and bears no relation to substitutions within the glass structure.

The structural changes brought about by substituting alkaline earth oxides for the alkali oxides differ from those caused by equimolar substitutions of SiO_2 in the overall chemical composition. When MgO or BaO are substituted for the alkali oxide in the glass composition the change is a replacement of two alkali ions by one Mg^{2+} or one Ba^{2+} ion. However, the number of bridge-forming oxygen ions

$$\left(\,\begin{array}{c}|\\ -\mathrm{Si}-\mathrm{O}-\mathrm{Si}-\\ |\end{array}\,\right)$$

remains constant as does the number of broken oxygen bridges $\left(\,\begin{array}{c}|\\ -\mathrm{Si}-\mathrm{O}\,\mathrm{X}\,\mathrm{O}-\mathrm{Si}-\\ |\end{array}\,\right)$, where X = a mono or bi-valent cation. When SiO_2 replaces Na_2O in the chemical composition, the proportion of Na_2O to SiO_2 is effectively decreased; thus,

$$(1-x)\,Na_2O\cdot(3+x)\,SiO_2$$

is equivalent to

$$[3(1-x)\ /\ (3+x)]\,Na_2O\cdot 3SiO_2.$$

Hence, an increase in SiO_2 content increases the number of bridge-forming oxygen ions.

The acidity of glass increases when the alkaline earth oxides are substituted for the alkali oxides because the oxygen ions forming broken bridges will be more strongly bonded to the Mg^{2+} and Ba^{2+} ions than to the alkali ions. When SiO_2 is substituted for the alkali oxides the acidity increases as a result of the increase in bridge-forming oxygen ions. In both cases, the average polarization of the oxygen ions is increased.

In general the stronger increase in the acidity brought about by the alkaline earth oxides as compared to that for SiO_2 is interpreted as being primarily a function of the larger number of broken oxygen bridges which become associated with alkaline earth ions. Although the field strengths of Mg^{2+} and Ba^{2+} are low as compared to Si^{4+}, these ions can polarize a relatively large number of non-bridging oxygens by virtue of their higher coordination numbers. Si^{4+}, on the other hand, can polarize only two additional oxygen ions when added as SiO_2.

The effect on potentials when MgO, BaO and SiO_2 are

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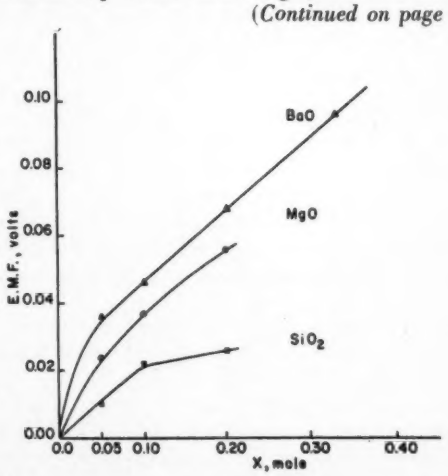

Fig. 13. E.M.F. vs x moles of MgO, BaO or SiO_2 substituted for Li_2O in $Li_2O\cdot 3SiO_2$ at 500°C.

Woven Wire Feeder Belts in the Glass Industry

By J. F. REID
The Cambridge Wire Cloth Company, Cambridge, Maryland

• AMONG THE MANY APPLICATIONS for woven wire conveyor belts in the glass industry, i.e. annealing and decorating lehrs, mold cleaning, cullet conveyors, etc., one is rapidly becoming more widespread in use. It is the application of this type of belting to the feeder lines used to carry ware from the forming machines to the annealing lehrs. Normally, these conveyors range from 10 to 50 feet in length, with the average being about 25 feet long, and in widths varying from 4 to 12 inches with the average about 8 inches.

There are, of course, other types of belting used on feeder lines, namely asbestos and chain link. However, there are many reasons why woven wire feeder belts are becoming increasingly popular.

Since the woven wire belt is of all metal construction, it will not absorb oils or greases. Thus, the danger of staining or marking the ware from oil or grease contact is minimized. Moreover, checks can be further reduced by occasionally giving the belt a good cleaning with either a wire brush or a chemical cleaning solution to remove surface grime and grease. Also, because the all metal belt is impervious to damage from temperature, the belt can be preheated before it receives the hot ware to further minimize the possibility of checks as the ware moves from the forming machine onto the belt. Where a comparatively long span must be traveled between the forming machine and the lehr, the belt can be passed through a flame tunnel to make sure that the ware remains at a constant and uniform temperature during its trip to the lehr. In such an installation, the open mesh of the woven wire belt provides free circulation of the heat for uniform treatment of the ware.

Woven wire belting has proven to be up to three times more durable than other types of belting used for feeder lines. This ratio was established a number of years ago by a large glass producer who found that this extra life made woven wire belts the most economical for feeder lines even though their initial cost may be as much as 92 per cent higher. Of course, this longer belt life also means less production time lost because it is not necessary to shut down for belt replacement as frequently as with other types. The same company indicated their experience showed that woven wire feeder belting is less conducive to shrending the hot ware, thus reducing rejects and consequent waste.

Another advantage of woven wire feeder belts is that they are exceptionally easy to keep dry which is essential where hot glass is concerned.

Still another important point is that woven wire feeder belts can be operated on a curve where it is necessary to swing the feeder line around machinery or obstructions. The greater the arc of the curve, of course, the more easily the belt will operate and no special equipment is required.

Various Weaves Available

As is the case with the selection of a specific woven wire belt for the annealing or decorating lehr, careful attention must be paid to every detail in selecting the specific woven wire belt for the feeder line. The mesh size may be varied to meet requirements that may range from a very small close mesh to provide a smooth, non-tipping carrying surface to a relatively open mesh for lines where it is necessary or desirable to have air passing through the belt and around the ware.

The three types of belting most frequently used today are the Balanced weave, the Duplex weave and the Gratex weave. Illustrations of each of these in the actual size most frequently used are shown on the opposite page. Here is data regarding essential characteristics of each type.

Balanced belting — is low in ultimate cost, provides high tensile strength and straight belt travel, is highly resistant to distorting strains due to its balanced construction. Balanced weave is also very easy to repair should it become necessary to replace certain sections.

Duplex belting — provides the closest mesh, thus the smoothest carrying surface, also provides high tensile strength and allows straight belt travel. Duplex construction is more difficult to repair than Balanced due to its dense, compact structure.

Gratex belting — offers the same advantages as Balanced belting and provides almost as close a mesh as the Duplex. Its main advantages over Balanced belting is that it provides a stronger construction, thus may yield longer life under heavier loads.

Proper Installation, Maintenance

On any feeder conveyor, the same as any other woven wire belt conveyor, certain precautions must be taken in installing the belt to provide for maximum performance. For example, the belt should be properly supported by either closely spaced rollers or a slider bed beneath the carrying surface of the belt. The drive pully should be of a diameter adequate to prevent slippage or, if a small diameter drive pulley is used, it should be lagged or snub rollers should be provided to increase traction. It is generally necessary to provide for a belt takeup as some stretching may be noted.

Preventive maintenance, of course, is just as important in contributing to maximum feeder belt life as it is to the life of belts in annealing and decorating lehrs. One way by which operators can get maximum feeder belt life from woven wire belting is to make certain to reverse, or turn the belt over, periodically so that wear occurs uniformly rather than only in certain areas. However,

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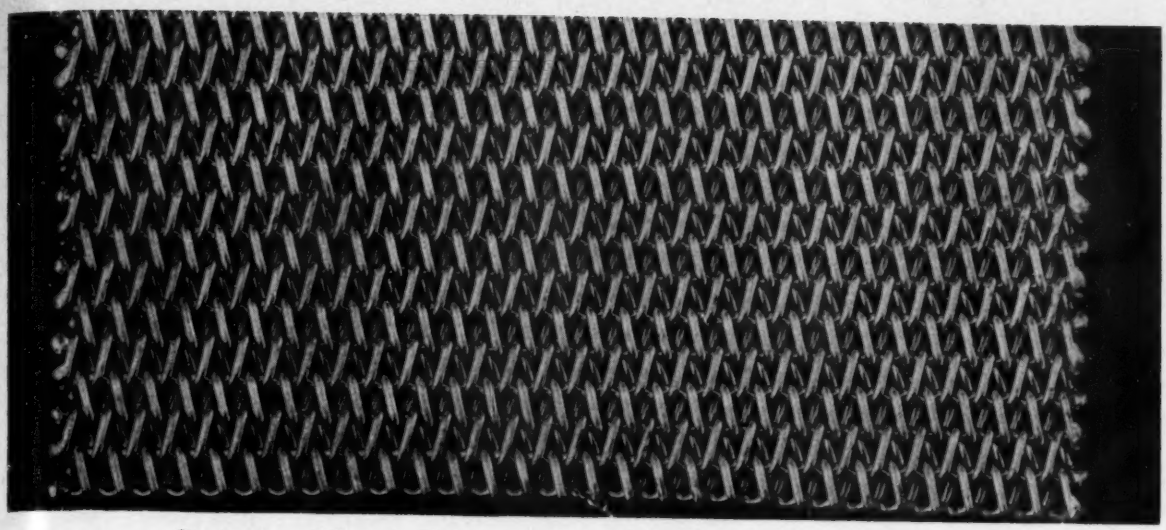
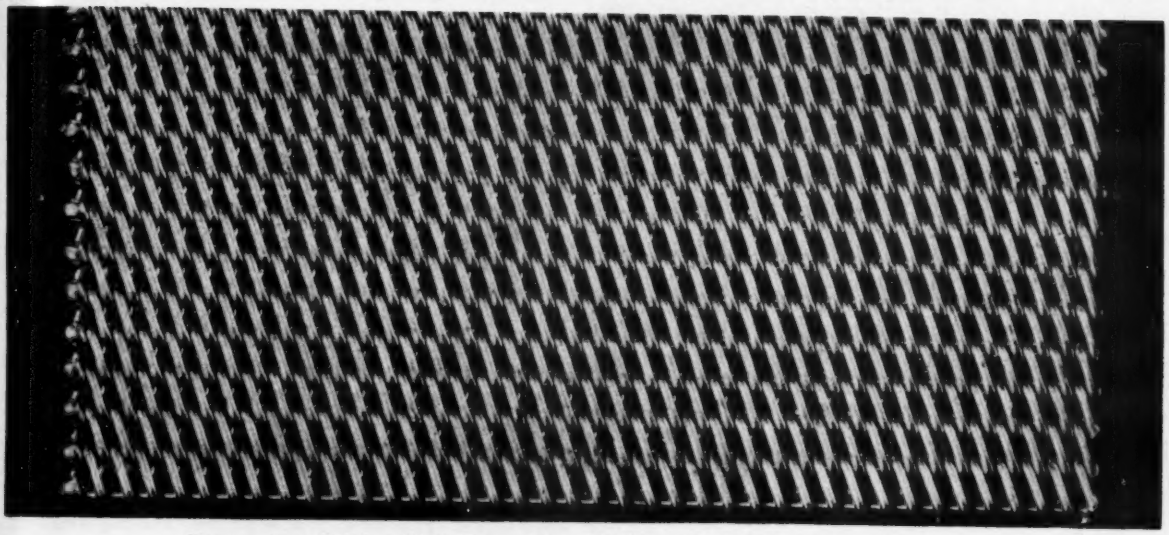
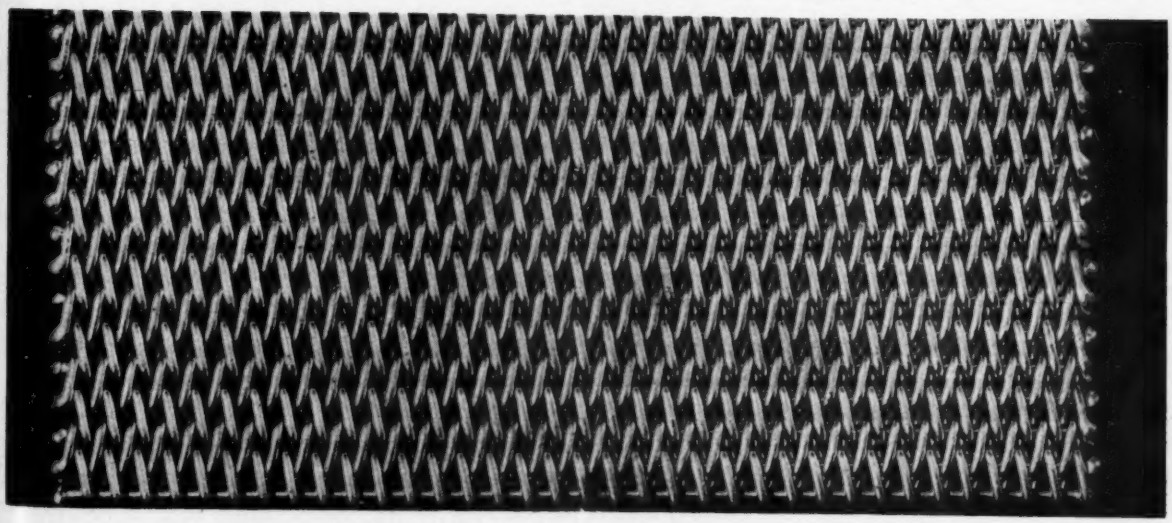


Construction: Balanced; Mesh Count: B-60-55-16; Material: Steel; Weight: 3 lbs.



Construction: Duplex; Mesh Count: 7 to 16; Material: Steel; Weight: 4 lbs. 2 oz.



Construction: Gratex; Mesh Count: G-69-60-14-16; Material: Steel; Weight: 4 lbs. 6 oz.

Decline in Japanese Glass Container Industry

• PRODUCTION OF GLASSWARE in Japan has expanded rapidly since the war, but a leveling off is now evident in many items and glassware makers report local sources are faced with the need to adjust to new conditions. Glass bottles and jars are no exception to the prevailing situation, according to Mr. Yasuji Shibata, chief of general affairs at Yamamora Glass K. K., the biggest bottle factory in the Kansai and the second largest in Japan. The production of beverage bottles, jars and pharmaceutical vials is the most important (70 per cent of total output) of the several categories of the Japanese glassware industry (not including sheet glass). The items in this category lend themselves to production on automatic machinery; assembly line producers predominate. The bulk of output is accounted for by nine companies with twelve plants: Nihon Glass, Tokyo; Toyo Glass, Osaka; Ishizuka Glass, Nagoya; Shin-Nihon Glass, Osaka; Oha Glass, Osaka; Yamamura Glass, Nishinomiya; Hiroshima Glass, Hiroshima; Daiichi Glass, Tokyo; Kirin Beer Company, Yokohama.

In addition to these large plants, there are a sizeable number of small producers, some partly mechanized, which make, in small lots, fancy jars and other containers, mostly for the cosmetic and pharmaceutical trades. Mr. Shibata reports that the large plants are currently producing at the rate of 25,000 tons per month. He estimates that of this total, beverage bottles account for 18,000 tons, medicinal vials 3,000 tons and condiment containers 2,500 tons. Production has increased steadily in the last few years. Some 220,000 tons were reported for 1953; while 1955 totaled well over 300,000 tons. National production is shown below:

	1955	
Beer bottles	15,485 tons	Usually products of automatic plants
Sake bottles	88,008 "	
Milk bottles	20,523 "	
Soft drink bottles	40,110 "	
Wine bottles	21,961 "	
Food Containet	23,494 "	
Others	22,112 "	
Sub Total:	231,693 tons	
Cosmetic jars	27,816 tons	Usually products of small plants
Pharmaceutical vials (industrial & medicinal prep.)	45,444 "	
Total:	304,953 tons	

Small manufacturers are found scattered across the country. The bigger companies, however, are concentrated in the metropolitan areas. The Osaka-Kobe area alone accounts for about half of the total production, while Tokyo is second with approximately 25 per cent of the national output. There is one plant in Hiroshima which produces 2,500 tons and another in Fukuoka with a monthly output of 2,000 tons. Nagoya is another important area of production.

Mr. Shibata explained that a price drop has hit the large producers quite hard. Plants have been making strenuous efforts to increase capacity and to rationalize production in an attempt to keep down prices, but the industry now finds itself over-producing. This condition has been aggravated by a recent decline in demand, in what the industry terms made-to-order bottles. Stock orders, that is standard milk, sake, and beer bottles, have kept up and the increase in demand for these meets anticipations, but sales of made-to-order bottles are down for unexplained reasons. The net effect has been a slump in prices, illustrated by the following wholesale quotations:

December 1955 Prices	*1954 Prices*
Flint $88.89 per ton	Flint $102.78 per ton
Amber $66.67 per ton	Amber $69.44 per ton
Blue-green $61.11 per ton	Blue-green $69.44 per ton

Mr. Shibata claims that his company is the only major producer not in the red. He states it has been able to prosper because of its long-established business standing, because it has developed a better quality glass and can thus command a higher price, and because of its proximity to the large breweries.

With the drop in sales of usual lines, the large-scale manufacturers have turned to the production of the cosmetic jars and vials formerly reserved to the small operators. Improvements in technique, whereby the economical level of production has been lowered from 100,000 to as low as 30,000 units, is making this shift possible. Small-time producers, faced with increased competition from the automatic machine plants, are reported to be in a precarious position and to be turning to production of other glass.

A problem which all the manufacturers face is the competition from second-hand bottles. On the average, about 20 per cent of beverage bottles are replaced after each usage. The trade in second-hand bottles is well organized, and the cost of reclaiming and washing the bottles is going down. The need to keep new bottle prices down to a competing level serves as a price depressant.

Foreign trade is not important to this industry, but sales overseas have been steady and are expected to continue at the same level. Approximately 1,000 tons, mostly soft drink bottles, are exported each month to Southeast Asia via trading houses. Singapore, Hong Kong (for trans-shipment to Indonesia) and the Philippines are the principal customer countries. There is now in the Philippines a native large-scale producer, but because of the prevailing shortage of capital investment and technique in the other countries of the region, it is not anticipated that mass production will soon be introduced. In prewar days, China was a big customer but at present purchases no bottles. West Germany is Japan's principal competitor in the area. Germany's production costs are considerably lower than Japan's because of cheaper raw materials, and in spite of the long distances involved, can often undersell the Japanese.

Excerpted from Monthly Economic Notes—Kobe (Japan) Consular District (Foreign Service). Department of Commerce.

Inventions and Inventors

Annealing and Tempering

Glass Bending Mold. Patent No. 2,737,758. Filed November 10, 1953. Issued March 13, 1956. Three sheets drawings; none reproduced. Assigned to Libbey-Owens-Ford Glass Company by Joseph E. Jendrisak.

The present invention relates broadly to the shaping of glass sheets or plates to a predetermined curvature, and particularly to an improved bending mold and means for supporting a glass sheet on it.

By means of a novel mold construction, the glass sheet is locatable in end areas of the mold. Portions of these areas are employed to sustain or support the sheet in balance and in proper registration with the shaping surfaces of the mold, until the marginal areas of the sheet are received thereon.

It is an aim of the invention to provide an improved bending mold of hinged construction, which will support a flat sheet in balanced relation to the shaping surfaces thereof; subsequently carrying it into the final bent shape, while continuing to support the ends of the sheet in proper registration to said shaping surfaces until it reaches the end of its bending movement.

There were 11 claims and the following references were cited in this patent: 1,999,558, Black, Apr. 30, 1935 and 2,518,951, Smith, Aug. 15, 1950.

Feeding and Forming

Adjustably Controlled Glassware Transfer Mechanism. Patent No. 2,740,382. Filed September 26, 1952. Issued April 3, 1956. Two pages drawings; none reproduced. By William R. Morgan.

The present invention relates to a glassware transfer mechanism, and more particularly to one in which a vacuum head is pneumatically displaced and inverted from one predetermined position to another.

The transfer device involves a support on which is mounted a pneumatic motor, having a piston rod, connected by appropriate linkage to the movable vacuum head. A means for adjusting the stroke of the piston rod is provided in the form of an adjusting screw which is engaged through the cylinder head opposite that through which the piston rod passes. This screw may be adjusted along the axis of the motor cylinder so as to abut with the retracted piston; thus limiting the total stroke of the piston at a desired point. The crosshead is connected to the piston rod for movement therewith, and the latter extends beyond the crosshead for pivotal connection with a connecting rod. The connecting rod is adjustable in length and is, in turn, connected to a bell crank lever. The adjustability of the connecting rod, in conjunction with the ability to adjust the stroke of the motor piston, enables the vacuum head, which is connected to move with the above-mentioned bell crank, to be adjusted to appropriate predetermined limiting positions.

A smoother operating glassware transfer mechanism is provided through the elimination of sliding surfaces and the substitution of frictionless bearings.

There were 5 claims and the following references were cited in this patent: 1,165,811, Stafford, Dec. 28, 1915; 1,206,707, Hunter, Nov. 28, 1916; 1,230,049 Stafford, June 12, 1917; 1,295,934, Snyder, Mar. 4, 1919; 1,370,924, Smith, Mar. 8, 1921; 1,863,448, Landenberger et al., June 14, 1932; 2,252,939, McCoy, Aug. 19, 1941; 2,373,226, Coates, Apr. 10, 1945, and 2,637,054, Holmes, May 5, 1953.

Control Mechanism for Machines for Bottles. Patent No. 2,739,695. Filed Dec. 28, 1951. Issued Mar. 27, 1956. 4 pages drawings; none reproduced. Assiged Haybar Limited by George W. Haycock.

This invention relates to control mechanism in machines which work on bottles, jars and like articles, that are conveyed in succession to the working zone of the machine and which depend for their satisfactory operation on a regular supply of such articles to said zone. In the preferred practical construction, the control mechanism has, as a component driven in unison with the machine, a lever which is recurrently rocked by a machine-rotated cam. The mechanism has, as a checking component turned by the articles, a star-wheel which is engaged and turned stepwise by the articles in their passage to the machine; the mechanism also has a specially formed stop wheel which is connected with the star-wheel so that both turn in unison, and formations of which cooperate with the lever. The arrangement is such, that should there be a failure in the supply of articles, counted as individuals or counted as batches, the stop wheel displaces the lever to stop the machine. The stop wheel may have formations in the nature of a rim with one or more openings, and the lever may have a projecting tongue, capable of freely entering any of the openings, and a spring-loaded fulcrum which is displaceable when the lever is rocked and the tongue fails to register with and enter the opening or an opening.

There were 18 claims and the following references cited: 1,281,580, Johnson, Oct. 15, 1918; 1,659,831, Mudd, Feb. 21, 1928; 2,052,840, Nussbaum, Sept. 1, 1936; 2,515,965, Nurnberg, July 18, 1950, and 2,599,221, Bergmann, June 3, 1952.

Furnaces

Means for Applying Heat to Ring of Molten Glass Feeder. Fig. 1. Patent No. 2,725,682. Filed May 11, 1954. Issued December 6, 1955. One sheet of drawings. Assigned Emhart Manufacturing Company by W. T. Honiss.

This invention relates to improvements in glass feeders of the type which comprises a molten glass feeding container provided with a downwardly opening outlet in its bottom through which molten glass is fed, and more particularly to means for applying heat locally to the exterior of the lower end portion of a refractory orifice ring at the lower end or bottom of the glass feed outlet of such a feeder.

A burner noozle unit 40 (See Fig. 1.) is provided to

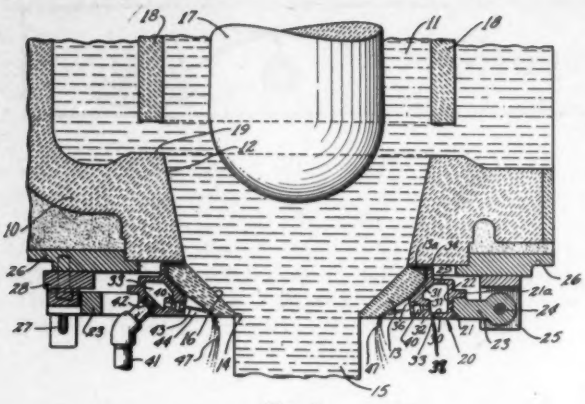


Fig. 1

fit snugly in relatively enlarged outer end portion 38 of each burner port. From the chamber 33, gaseous fuel will pass through the burner ports 36 so as to be directed as jets 43 against the outer surface of the lower end portion of the orifice ring. The ports 36 are all turned laterally from the radial in the same direction, reading from the inner surface of the inner wall 32 to the outer surface thereof. This lateral slant from the radial preferably is in the order of about 20°. These ports also slant slightly downward toward their outer ends, as in the order of approximately 8°. The closely adjacent jets of flame 43 thus will be slanted laterally and also slightly downward as they pass through the intervening space 44 to the lower portion of the orifice ring. It will be noted that these flames or gaseous products of combustion curl away from the depending molten glass charge mass of column 15. Overheating of this mold charge mass thus is avoided. Consequently, the burner may be operated to its full capacity if necessary to heat the orifice ring to the extent desired and this without any objectionable heating of the suspended mold charge mass of glass below the feeder outlet.

There was one claim and the following references were cited in this patent: 1,603,196, Cramer, Oct. 12, 1926; 1,775,311, Halle, Sept. 9, 1930; 2,252,320, Hughey, Aug. 12, 1941, and 568,428, Great Britain, April 4, 1945.

Glass Compositions

Radiation Sensitive Glass. Patent No. 2,722,519. Filed November 3, 1952. Issued November 1, 1955. Assigned to the United States of America, by K. O. Otley and W. A. Weyl.

This invention relates to radiation detectors and more particularly to a glass which fades when subjected to high energy radiation.

It has been found that if sulfur or an alkali sulfide is incorporated into a sodium borate glass of relatively low acidity, a brown glass is obtained which derives its color from the formation of polysulfides. On addition of some boric acid, this glass changes its color to blue, probably because of the formation of S_2 molecules. The glass has an absorption spectrum with a broad maximum between 5000 and 6000 Angstrom units. Upon irradiation with X-rays, this absorption band decreases and the blue glass is progressively bleached. The change in color may be observed either with a visual or photoelectric photometer.

Such a blue glass is prepared by melting 20 parts of sodium tetraborate, with 10 parts of boron trioxide, and 1.5 parts of pure sulfur in a Globar furnace at 900°C. This glass is gradually bleached when it is exposed to high-energy radiation such as X-ray or gamma radiation. Potassium and aluminum may be substituted for the sodium in this glass and the blue glass can also be prepared by fusing sulfur with potassium aluminum borate by the same aforementioned method.

When exposed to high-energy radiation, this blue glass is equally sensitive to both X-ray and gamma radiation. Small amounts of radiation have a measurable effect upon the glass and it is, therefore, possible to set up a calibration scale for different depths of blue corresponding to different doses of high-energy radiation.

There were 2 claims and the following references cited in this patent: 971,124, Egly, Sept. 27, 1910 and *Chemical Abstracts*, vol. 33, page 824 (1939).

Glass and Wool Fiber

Reinforced Fibrous Products. Fig. 2. Patent No. 2,732,885. Filed November 19, 1949. Issued January 31, 1956. Two pages drawings. Assigned Owens-Corning Fiberglas Corp. by W. G. Van Der Hoven.

This invention relates to fibrous products formed from individual fibers and stranded materials and to a method and apparatus for producing mats, sheets or bats of fibrous material reinforced with strands or yarns forming integrated assemblies for use in various industrial applications and as adjuncts useful in manufacturing and fabricating other products.

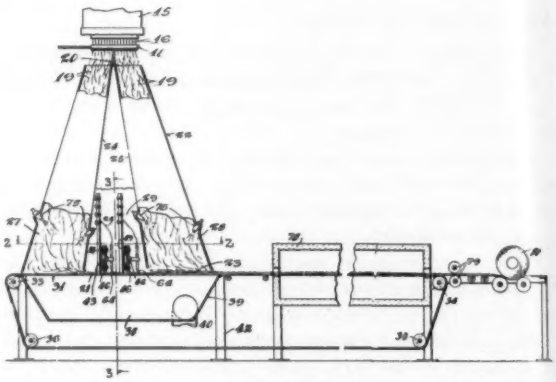


Fig. 2

Disposed immediately below the blower 18, Fig. 2, centrally thereof is a shield or divider member 20, preferably of wedge shaped configuration, which serves to divide or separate the moving fibers 19, into two groups. The groups of fibers pass downwardly through an enclosure or forming hood 22. Centrally disposed in the hood 22, is a pair of diverging walls 24 and 25, the upper ends of which cooperate with the divider 20 to maintain the two groups of fibers in different zones. The walls 24 and 25 separate the enclosure 22 into chambers 27, 28 and 29, the two groups of fibers being respectively conveyed downwardly, through the chambers 27 and 28. The individual fibers produced in the above manner described, are of varying lengths and are intermingled indiscriminately, the fibers doubling back and

forth on themselves and are collected in a haphazard mass near the base of the hood or the enclosure 22, the collected mass forming a lower or bottom layer of fibers 21.

There were 5 claims and the following references were cited in this patent: 921,674, Clark, May 18, 1909; 1,338,164, Angier, Apr. 27, 1920; 2,165,280, Lannan, July 11, 1939; 2,477,555, Roberts et al., July 26, 1949; 2,481,949, Richardson, Sept. 13, 1949; 2,528,091, Slayter, Oct. 31, 1950; 2,543,101, Francis, Feb. 27, 1951; 2,552,124, Tallman, May 8, 1951, and 17,549, Great Britain, 1898.

Glass Fiber. Fig. 3. Patent No. 2,720,728. Filed July 12, 1951. Issued October 18, 1955. One sheet of drawings. Assigned to International Harvester Company, by Joseph F. Courtney, and Adelbert C. Radtke.

This invention relates to an apparatus for attenuating thermoplastic material and has particular reference to the manufacture of glass filaments.

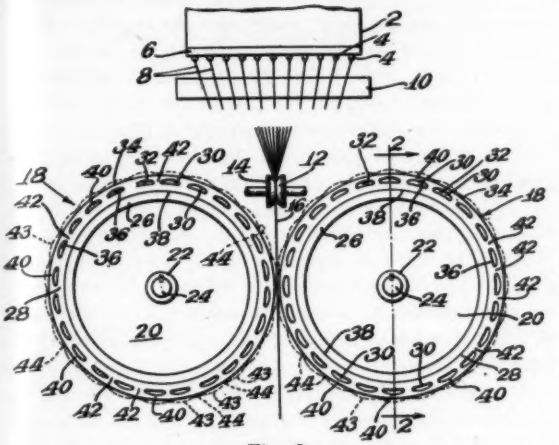


Fig. 3

Referring to Fig. 3, filaments are drawn by an operator into a peripheral groove 12, in a gathering sheave 14, which is adapted to associate the filaments 8, 8 into a strand 16, such strand being entered between a pair of opposed drawing rolls or elements generally designated 18,18.

Each roll 18 comprises preferably a metallic wheel or disc 20, having a hub 22, suitably keyed to a driving shaft 24. The outer edge of the plate 20, is formed with a rim 26, about which is disposed a circumscribing annulus 28, which is formed of yieldable resilient rubber-like material such as soft rubber. It will be seen, as represented by phantom lines, that each segment 40 will expand or bulge radially outwardly, due to the imposition of a centrifugal force pursuant to rotation of the related member 18, in a manner which develops or distorts the normally cylindrical surface 34 into an undulant or wavy contour. The thinnest portion of each section 40 bulges outwardly the greatest distance, the bulging progressively decreasing as the section becomes thicker toward each of its circumferentially spaced ends. The construction of the slots 30, 30 by the provision of a radius at each end of the surface 32 avoids concentration of stresses which would tend to tear the material. At the same time, the construction is such that the lightest part of each section 40 is caused to effect maximum deflection or strand whereby a light gentle deflecting action is obtained.

This feature produces a modifying effect in the initial engagement of the lightest mass at crest 43 of each bulge in that it may be moved or flattened inwardly momentarily as it engages the strand and then recover the bulge outwardly to press it into the mating concavity 44 on the opposed roll at the grasping region of the rolls. The yielding nature of the grasp is conducive to the formation of a strand which is substantially uniform and throughout its length which is devoid of transverse deformations and the like.

There were 3 claims and the following references cited in this patent: 437,208, Kinney, Sept. 30, 1890; 627,483, Comly, June 27, 1899, and 906,569, Seiberling, Dec. 15, 1908.

Reinforced Fibrous Products. Fig. 4. Patent No. 2,731,066. Filed April 20, 1949. Issued Jan. 17, 1956. 3 sheets drawings. Assigned Owens-Corning Fiberglas Corp. by H. R. Hogendobler and A. L. Simison.

This invention relates to manufactured products formed of mineral fibers and strands, and more especially to matted or webbed fibrous products reinforced with strand materials. and to methods and apparatus for producing same.

The streams of molten glass are acted upon by gaseous blasts issuing from jets of a blower 12, Fig. 4. The action or impingement of the gaseous blasts upon the glass streams attenuate or draw the glass into relatively fine fibers 13, which pass downwardly through an enclosure or hood 14. As they are collected, the fibers double back and forth on themselves to form a web, or mat in which the fibers are all individually arranged into a substantially completely haphazard pattern.

Disposed beneath the hood 14 is a fiber collecting surface, preferably in the form of a conveyor 15, of the endless type, and of a foraminous character. The fibers 13 are forcibly deposited by the gaseous blasts emanating from the blower 12, upon the upper surface of the conveyor 15, which provides a collecting zone in which the mat is formed.

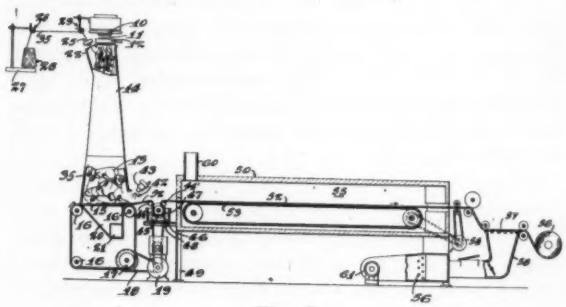


Fig. 4

As the composite mat moves from beneath the hood 14, on the conveyor, the fibrous masses may be treated with a bonding or fixing agent or adhesive 42, which is usually in liquid form and may be sprayed upon the mat by means of a jet 43 connected to a reservoir or supply (not shown) of bonding material. The composite sheet or mat is conveyed over a roller 44 and around

(*Continued on page* 460)

Effect of Certain Organic Liquids on Strength of Glass

Previous work showed that glass fibers when broken under water dropped in strength, as compared to fibers broken in air. In the report by Moorthy and Tooley, *Journal of the American Ceramic Society, June 1956*, the effects of water and non-aqueous medium on the breaking strength of glass fibers is compared. As non-aqueous media, methyl alcohol and its homologues in the series, certain hydrocarbons and certain aromatics were used.

The data obtained brought out the following points: (1) The strength of freshly prepared specimens was lower in water than in air. (2) In all cases except one (nitrobenzene) breaking strength under the organic liquid used was greater than the strengths under water. (3) The chemical nature of the liquid touching the glass exerted a marked influence on the measured strength. Breaking strengths were highest under alcohols of low molecular weight and lowest under more inert liquids. Based on data relating to straight-chain monohydric alcohols, breaking strengths decreased as chain length increased. (4) There is a strong suggestion of decreased breaking strength as the general bulk of the organic molecule increased. Long-chain alcohols and aromatics tended toward lower increases in strength compared with short-chain alcohols. (5) There is some evidence that certain surface treatments influenced strength in an additive way. Certain experiments indicate that strength changes brought about by the action of liquids under which the specimens were broken were superimposed to some extent on strength changes brought about by the previous surface treatment.

To explain this behavior of organic liquids on the glass surface several hypotheses, chiefly from a conjectual standpoint, were suggested by the authors.

If it can be assumed that a glass surface is stronger when its original residual sufarce charge is satisfied, and when surface ions are more uniformly distributed, then an explanation of the strength behavior of glass in organic liquids can be postulated in terms of the nature of this glass surface and the nature of the liquid in contact with this surface.

Glass is pictured as a random network of silicon-oxygen-tetrahedra, with modifier cations occupying the interstices between the interbonded tetrahedra. Such a coordinated structure implies the existence of unsatisfied surface charges nonuniformly distributed on the surface. On the average it would seem reasonable that unsaturated oxygen charges would be more uniformly distributed on the glass surface than would the modifying cation charges, since the surface oxygens would be more firmly confined by the basic structural pattern of interconnected tetrahedra. Following this reasoning, it is suggested that less firmly bonded cation charges (modifier type) would offer a greater probability of becoming nonuniformly distributed when passing from the liquid to the rigid condition. Any liquids possessing functional groups that could react with unsaturated charges on the glass surface, or containing traces of other molecular species that could react with these sufficiently to transport such charges to more stable equilibrium conditions, would thus bring about both the saturation and the more uniform distribution of such charges and, therefore, would tend to minimize flaws on the surface. This conjectural hypothesis assumes that (1) a flaw is considered analogous to a zone of abnormal concentration of positively charged modifier ions only a few surface ions in area as, for example, a zone of fifteen to twenty surface ions, and (2) the liquid in contact with the glass, although capable of mild reactivity with it, does not react to the extent that the basic tetrahedral structure is attacked. It is this condition that emphasizes caution in attempting to compare the action of water with the reaction of less-reactive liquids on the glass surface since, in the case of water, it is evident that the actual glass net-work is attacked, particularly so, for glasses containing alkali.

Reasons for variations in strength of glass in contact with different nonaqueous liquids, according to the foregoing view, must be sought in terms of interfacial chemical reactions between the glass surface and the liquid. Following this, one would expect the strength behavior of glass to be affected, more by polar than by nonpolar liquids. The experimental data afforded by this study are not sufficient to warrant a detailed interpretation of strength changes in terms of the polar character of the liquids employed.

At least one other hypothesis regarding the effect of the alcohols on the strength of glass must be considered seriously, and in some respects it appears more valid than the foregoing hypothesis.

There is abundant evidence that the immediate effect of the attack of water on many glasses is a decrease in breaking strength. When glass is under a tensile stress, hygroscopic water on the surface is permitted to penetrate flaws more easily. Any chemical agent having dehydrating properties and the ability to penetrate the flaw, should, therefore have a beneficial effect on strength, provided the agent does not have a destructive chemical effect on the glass network. Following this view, one should expect in the case of the alcohols, to obtain the greatest increases in glass strength with (1) molecules of small bulk, i.e., short chain, in the interest of the ability to penetrate flaws and (2) liquids showing a great ability for taking water in solution. Of all the organic liquids studied, this dual specification is met most adequately by the alcohols. In the case of the straight-chain monohydric alcohols, the positive effect on strength decreases in a regular manner with increase in chain length. An interesting result was the effect of nitrobenzene on glass strength. It is detrimental to strength giving a value about 10 per cent lower than the strength in air, a decrease comparable to that observed when fresh specimens are broken under water. From the sparing solubility of nitrobenzene in water, and the general bulk

(*Continued on page* 472)

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during May 1956 was as follows: *Flat Glass:* A preliminary figure of 30,500 for May indicates a decrease of 0.3 per cent from the adjusted 30,600 reported for April 1956. *Glass and Glassware, Pressed and Blown:* A decrease of 0.5 per cent is shown by the preliminary May figure of 82,700 when compared with 83,100 of April. *Glass Products Made of Purchased Glass:* The preliminary 15,400 indicates a decrease of 3.1 per cent from the previous month's 15,900.

Payrolls in the glass industry during May 1956 were as follows: *Flat Glass:* A decrease of 1.8 per cent is shown in the preliminary $14,292,605 when compared with April's adjusted $14,554,278. *Glass and Glassware, Pressed and Blown:* An increase of 1.3 per cent is shown in the preliminary $28,668,782 reported for May when compared with the previous month's adjusted $28,376,157. *Glass Products Made of Purchased Glass:* A preliminary figure of $4,454,450 was reported for May. This is a decrease of 3.2 per cent compared with the adjusted April figure of $4,604,640.

GLASS CONTAINER SHIPMENTS

(All Figures in Gross)

Narrow Neck Containers

	June, 1956
Foods	1,254,000
Medicinal and Health Supplies	1,176,000
Chemical, Household and Industrial	775,000
Toiletries and Cosmetics	811,000
Beverage, Returnable	1,138,000
Beverage, Non-returnable	136,000
Beer, Returnable	358,000
Beer, Non-returnable	921,000
Liquor	807,000
Wine	332,000
Sub-total (Narrow)	7,708,000

Wide Mouth Containers

Food	*3,227,000
Medicinal and Health Supplies	360,000
Chemical, Household and Industrial	173,000
Toiletries and Cosmetics	188,000
Packers' Tumblers	113,000
Dairy Products	202,000
Sub-total (Wide)	4,263,000
Total Domestic	11,971,000
Export Shipments	264,000
TOTAL SHIPMENTS	12,235,000

*This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures in Gross)

		Production June 1956	Stocks June 1956
Foods: Medicinal and Health Supplies; Chemicals, Household and Industrial: Toiletries and Cosmetics	Narrow Neck	4,506,000	5,742,000
	Wide Mouth	*4,154,000	*5,220,000
Beverage, Returnable		1,025,000	1,363,000
Beverage, Non-returnable		166,000	244,000
Beer, Returnable		356,000	386,000
Beer, Non-returnable		855,000	730,000
Liquor		844,000	1,125,000
Wine		379,000	576,000
Packers' Tumblers		119,000	179,000
Dairy Products		202,000	352,000
TOTAL		12,606,000	15,917,000

*This figure includes Fruit Jars and Jelly Glasses.

Glass container production: based on figures released by the Bureau of Census, was 12,606,000 gross during June, 1956. This represents an increase of 1.7 per cent from the previous month's production of 12,393,000 gross. During June 1955, glass container production was 12,219,000 gross or 3.1 per cent under June 1956 production. At the end of the first six months of 1956, glass container manufacturers have produced a total of 71,076,000 gross. This is 6.3 per cent over the 66,859,000 gross produced during the corresponding 1955 period.

Shipments of glass containers during June 1956 increased 0.8 per cent to reach 12,235,000 gross. This is an increase from May 1956 shipments which were 12,138,000 gross. Shipments during June 1955 were 12,330,000 gross or 0.8 per cent over June 1956. At the end of the first six months of 1956, shipments have reached a total of 67,368,000 gross, which is 3.2 per cent over the 65,055,000 gross shipped during the corresponding period last year.

Stocks on hand at the end of June 1956 were 15,917,000 gross. This is 1.5 per cent above the 15,673,000 gross on hand at the end of May 1956 and 11 per cent higher than the 14,327,000 gross on hand at the end of June 1955.

Automatic tumbler production: during May 1956 was 5,359,658 dozen. This is a gain of 12½ per cent against the April 1956 production, which was 4,760,949 dozen.

Production during May 1955 was 5,647,414 dozen.

Shipments during May 1956 dropped to reach 5,397,920 dozen. This is 4 per cent lower than the 5,618,054 dozen shipped during May 1955.

At the end of the twelve months period ending May 31, 1956, shipments have reached a total of 60,912,453 dozen, which is a 1 per cent decrease from the 61,507,327 dozen shipped last year.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware during May 1956 reached 2,755,395 dozen. During May 1955, sales were 2,834,307 dozen. At the end of the twelve month period ending May 31, 1956, manufacturers had sold a total of 36,553,336 dozen, which was 2.6 per cent lower than the 37,541,765 dozen during the corresponding 1955 period.

• Theodore Wachs, Jr., has been appointed manager of Corning Glass Works public relations office in New York City, it was announced by James M. Brown, director of the company's Division of Public Affairs.

New Equipment and Supplies

NEW LINE OF ELECTRONIC SCALES AND WEIGH BATCHING INSTRUMENTS

Fairbanks, Morse & Company, 600 S. Michigan, Chicago 5, Illinois recently announced a new conception in fast, accurate weighing and weigh batching. Employing electronic load cells, a complete line of weighing instruments has been developed that assures accuracy, faster weighing, plus the convenience of remote weight indication. Weight recording instruments may be located as much as 250 feet from the scale platform.

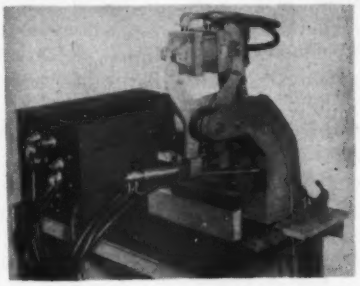
Two basic types of electronic scales are available — Full Electronic in which load cells replace the conventional lever systems and Levetronic in which a conventional lever system is used but with a load cell hooked in tension in the steelyard rod. The Levetronic system can be used to convert existing full mechanical scales to electronic weighing and instrumentation.

Standard instruments include the Model CR which incorporates such features as automatic balance detection, hold or memory circuit, automatic ranging, zero balance knob, net-gross switch and printer with selective "print" and "weight" buttons.

In addition to electronic scales, the line includes two unique electronic weigh batch control systems. The Batchetron is an electronic control system for batch weighing of any type of material that can be handled into the batch hopper by piping, conveyors or belts, or from overhead supply bins where materials are controlled by gates or valves. Through the instrument, each ingredient of a batch is pre-selected and automatically weighed and controlled through the batching operation. The operator merely preselects the ingredients according to formula, presets the required amounts on the instrument controls, and pushes the start button. Many auxiliary controls are available such as timers, batch counters, "read out" devices, etc.

The Fairbanks-Morse EPC . . . Electronic Program Control . . . is an automatic batch control unit that operates from a pre-punched card. Formulas are punched on a card and the card dropped into a card reader slot on the instrument. The EPC "reads" the card and automatically selects the right ingredients, weighs them in the weigh batch hopper, and discharges them to following process equipment. The chance for human error is virtually eliminated. Punched card formula control automatically insures exact duplication of formula every time. Complete literature on all new products is available by writing the company.

AUTOMATIC PINCH WELDER



Kahle Engineering Company, 1400 Seventh Street, North Bergen, New Jersey, has designed a new type series of automatic pinch welders for sealing metal exhaust tubes and similar applications.

The pinch welders are said to fill the many requirements of high-speed production of electronic tubes with metal tabulations. Production speeds of up to 60 welds per minute can be accomplished, the tubes being automatically self-centered for consistent quality and ease of operation. The electronic control precisely regulates each condenser discharge weld. A typical model is the pinch welder 2791 which can be adapted for use with either stationary or rotary exhaust equipment. Completely automatic units of various types for special or unique requirements are also available.

A brochure and additional information may be obtained by writing Mr. Eli Stiefel at the company.

TURBO BLOWERS

Hauck Manufacturing Company, 124-136 Tenth Street, Brooklyn 15, New York has recently placed a new line of turbo blowers on the market.

These blowers produce constant, dependable air pressure throughout their broad range of volume without pulsations, surgings or vibration. Their flat pressure performance curve makes them particularly desirable for air-fuel proportioning burners. They are said to be moderately priced and economical in power consumption.

The blower is equipped with a sturdy aluminum impeller and hub in a perfectly balanced impeller assembly. Blower casing is of fabricated steel with spun steel head having circular reinforcing rings. It is driven by a standard open frame ball bearing motor. The discharge position on direct motor-driven blowers can be rotated in the field to suit connection conditions. A flexible connecting sleeve with clamps is included.

The blowers are made in a large number of sizes from 250 cfm at 8 oz. pressure to 2650 cfm at 24 oz. pressure.

HIGH-HEAD DIFFERENTIAL METERS TRANSMIT LINEAR FLOW SIGNALS

Bailey Meter Company, 1050 Ivanhoe Road, Cleveland 10, Ohio, are manufacturing a new line of high-head differential pressure transmitters which utilize the accuracy of mercury U-tube measurements and which automatically convert a differential pressure to rate of flow, for metering and control.

These transmitters measure the rate of flow of steam, water, other liquids and gases producing maximum differentials from 100 to 1200 in. H_2O. The mercury U-tube is available for maximum service pressures of 800, 3,500 and 6,000 psig. Where mercury is undesirable, a bellows type is available for maximum service pressures of 1,500 and 3,500 psig.

Signals are SAMA standard, 3-15 psig. or 3-27 psig. Receivers may indicate, record and/or integrate. Since signals are linear with flow rate, measurements may be combined with other related factors on an evenly-graduated chart. For further details, write for product specification P22-6.

CATALOGS RECEIVED

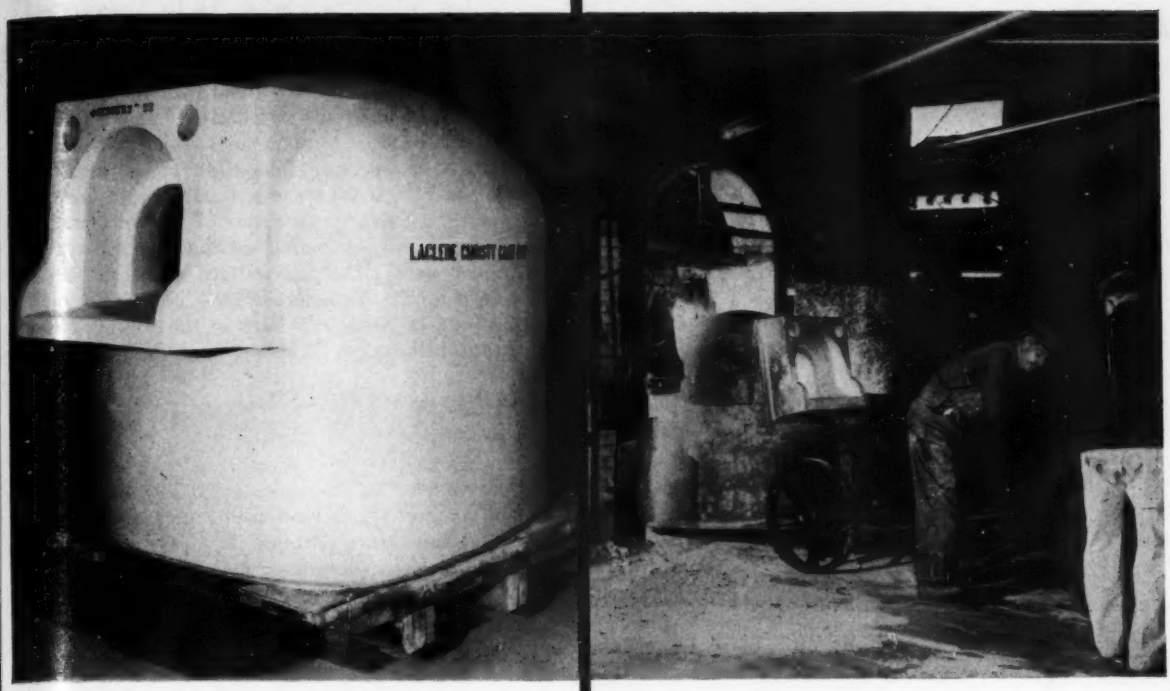
The Colorado Fuel and Iron Corporation, 575 Madison Avenue, New York, N.Y. has recently released two booklets. A new 16-page booklet "A profitable approach to the selection of steel processing conveyor belts" and a 12-page booklet supplementing its Wickwire Springs and Formed Wire catalog.

The booklet on the Wissco belts discusses the line of standard steel processing belts which will handle more than 90 per cent of all conveyorized processes requiring the durability and strength of a plain or stainless steel belt.

The 12-page booklet illustrates the various types of Wickwire springs and formed wire including compression springs, extension springs, torsion springs, flat wire springs, and formed wire. Complete specifications for ordering are detailed in the booklet. Copies of both booklets may be obtained from the advertising department of C. F. I.

The Consultants Bureau, 227 West 17 Street, New York 11, N.Y. have published the first issue of the English translation of the Soviet monthly journal "Steklo i Keramika", (Glass and Ceramics). Subsequent issues of the translation will appear at regular monthly issues. Subscription to the entire journal in translation is $80.00 per year. Individual articles, exactly as they appear in the published translation, may be purchased for $7.50. Tables of contents of each issue will be mailed without charge upon request from the Consultants Bureau.

Profitable trends in the use of refractories



Lower costs by getting more saleable ware with LACLEDE-CHRISTY 100% Cast Pots

You make more money on the high quality ware produced in Laclede 100% cast pots. Improved, uniform quality per melt means highest possible percentage of saleable ware.

Uniformity in mix and size of Laclede-Christy 100% cast pots, due to the casting process, means uniform expansion and shrinkage factors. Cracking in arching and setting is minimized—resulting in longer pot service life.

You save on fuel costs, too, with Laclede 100% cast pots. The denser pot body conducts furnace temperatures more rapidly, so that lower furnace temperatures are permissible. Lower temperatures mean less fuel plus longer pot life.

If you are not using Laclede-Christy 100% cast pots, investigate now. Your Laclede - Christy representative will gladly give you complete information. Be sure to call him soon.

LACLEDE-CHRISTY COMPANY DIVISION

LACLEDE-CHRISTY COMPANY — FOUNDED 1844 — Quality First

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Mission 7-2400

(*Continued from page* 443)

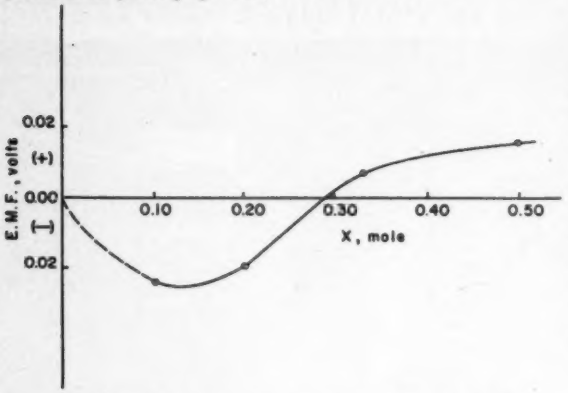

Fig. 14. E. M. F. developed at 500°C. by the cell $Ag/(1-x)K_2O{\cdot}xMgO{\cdot}3SiO_2//(1-x)K_2O{\cdot}xBaO{\cdot}3SiO_2/Ag$ with the potential of the electrode in contact with the Ba-containing glass taken as zero.

substituted for the different alkali oxides can be seen when Figures 5, 9 and 13 are compared. The variations in the potentials can be attributed to the differences in the electrostatic binding forces and coordination numbers of these ions. In the sodium silicate system, for example, MgO increases the acidity (higher potential) more than an equivalent amount of BaO. This is interpreted as being primarily a result of the stronger binding forces between the Mg^{2+} and O^{2-} ions, which leads to a greater polarization of the O^{2-} ions. The same relationship is found in the potassium silicate system at higher concentrations of RO. In contrast to this, the Ba^{2+} ion in the lithium silicate system has the strongest effect upon increasing the acidity. In this case the higher coordination number of the Ba^{2+} ion as compared with that of the Mg^{2+} ion must be responsible for the greater polarization of the O^{2-} ions.

It can be seen, therefore, that the predominance of the electrostatic binding forces or the coordination number upon acidity depends not only upon the size and charge of the ion, but also upon the environment into which the ion is introduced. In the simple alkali silicates the only difference in the systems is the size of the alkali ions which influences the structure[7]. In terms of the electrostatic binding to oxygen, the forces increase in the order $K^+ < Na^+ < Li^+$. Similarly, the coordination numbers of the potassium and sodium ions may be considered larger than that of the smaller lithium ion. It is possible, therefore, that the tightening of oxygens by increasing the electrostatic binding forces overshadows the tightening by increased coordination in a system where the alkali-oxygen bond is relatively weak. This would be the case in the sodium and potassium silicates (Figs. 5 and 7) where the Mg^{2+} increases the acidity more than the Ba^{2+} ion. In the lithium silicate system, however, where the lithium-oxygen bond is relatively strong but the lithium has a relatively low coordination number it is possible that the effect of increasing the coordination by non-bridging oxygens predominates in determining the acidity. Hence, Ba^{2+} with its relatively large size increases the acidity more than equivalent amounts of Mg^{2+}.

The magnitude of the potentials developed by the sodium, potassium, and lithium systems gives information which supports the above ideas. The simplest case to consider is that in which SiO_2 is added to the base glass, $R_2O{\cdot}3SiO_2$. In all three cases the acidity increases but the increase is greatest for the potassium silicate, intermediate for the sodium silicate and least for the lithium silicate. The effect of the coordination number of Si^{4+} may be assumed to be constant since each Si^{4+} is strongly bonded to four oxygens. The effect of the high ionic potential of Si^{4+} is to cause a tightening of the glass structure by a greater polarization of oxygen ions. The magnitude of this tightening depends on the type of alkali ion present. The polarizability of the oxygen ion is greatest in the potassium silicate where the alkali-oxygen bond is weak and least in the lithium silicate where the alkali-oxygen bond is stronger.

c. The Relationship Between Potentials and the Properties of Glass

Through the use of the oxygen electrode in glass systems as described in this series of investigations, potentials are obtained which have been shown to be a direct measure of the relative acidities of glasses. It should be possible, therefore, to use these potentials as a means to predict the effect of compositional changes on those properties which can be related to the acidity of glass. Among such properties chemical durability is perhaps one of the most important which can be considered.

In the first paper of this series[6], Weyl discusses the relationship between the acidity of glass and chemical durability on the basis of the polarizability of the oxygen ions. Glasses containing oxygen ions of lower polarizability are considered more acid and, therefore, more durable than glasses containing oxygen ions of higher polarizability.

(*Continued on page* 456)

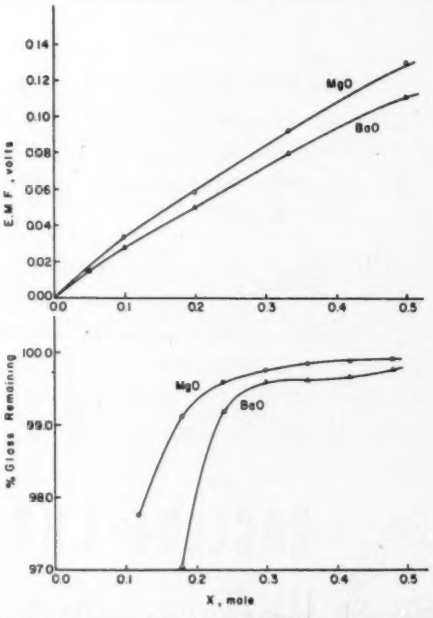

Fig. 15. Comparison of E. M. F. (500°C.) and durability of glasses in which x moles of MgO or BaO are substituted for Na_2O in $Na_2O{\cdot}3SiO_2$.

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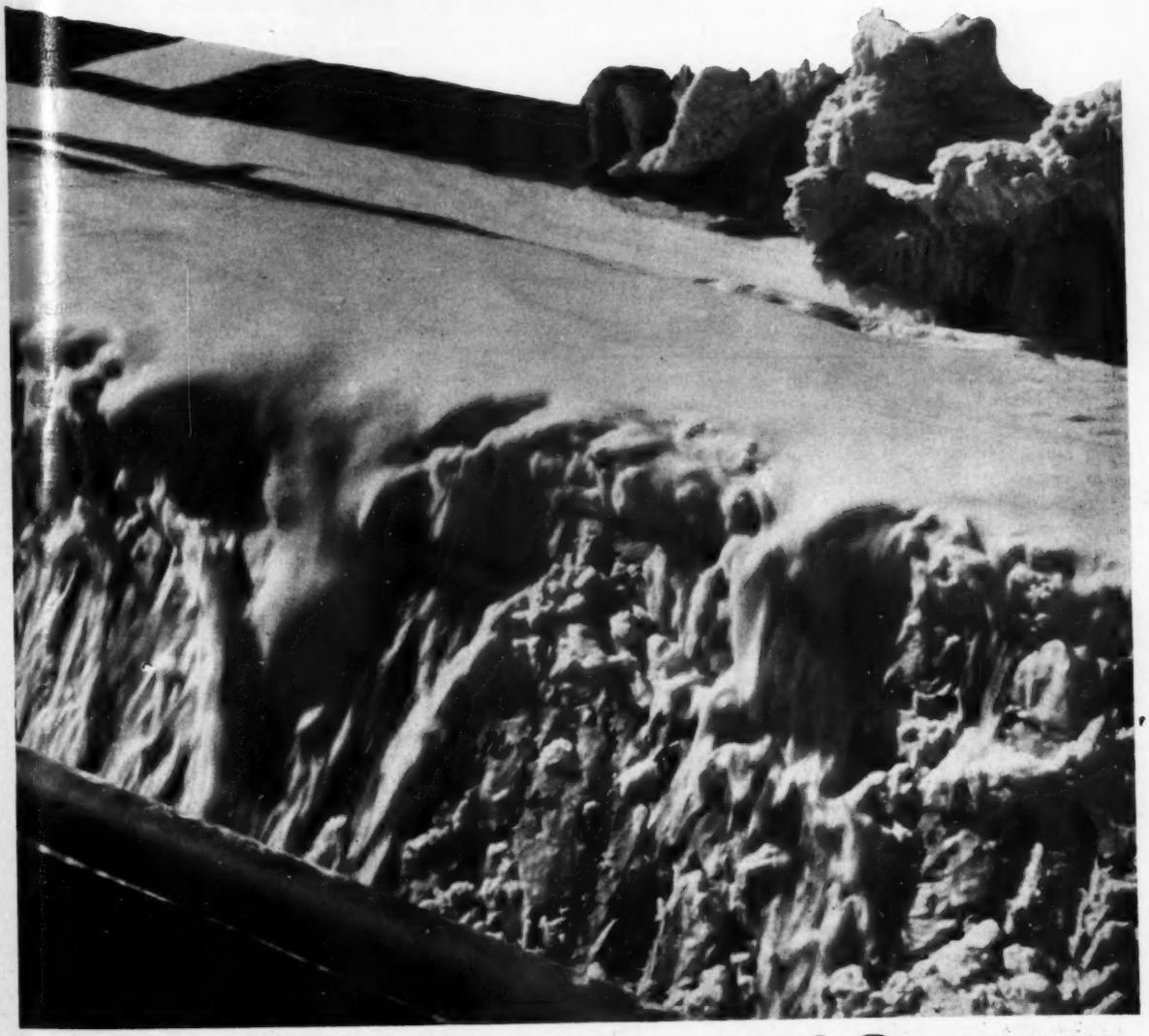

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Acid Base Relationship . . .

(*Continued from page 454*)

In support of this relationship, the work of Fraunhofer[8] has shown that potassium silicate glasses (weakly polarized oxygen ions) deteriorate faster than the corresponding sodium silicates (more strongly polarized oxygen ions). Turner and his collaborators[9] carried out systematic experiments with sodium silicate glasses, in which a number of oxides which included MgO and BaO replaced part of the Na_2O in $Na_2O{\cdot}3SiO_2$. Table IV shows the percentage loss in weight when these glasses were boiled in water for one hour.

TABLE IV

Action of Boiling Water on Glasses of the Formula $(2\text{-}x)Na_2O{\cdot}xRO{\cdot}6SiO_2$

(Dimbleby and Turner)

Moles RO per 100 moles SiO_2	Percentage Loss in Weight MgO Glass	BaO Glass
4	2.25	13.0
6	0.88	2.96
8	0.42	0.8
10	0.25	0.4
12	0.15	0.38
14	0.12	0.34
16	0.10	0.24

In all cases the sodium magnesium silicate (strongly polarized oxygen ions) is more durable than the corresponding glass containing barium (weakly polarized oxygen ions). In terms of acidity as expressed by Weyl this means that the sodium magnesium silicate is more acid than the sodium barium silicate. Precisely the same relationship of acidity has been established by the measurements of potential presented in this paper. It thus becomes possible to relate the potentials obtained using the oxygen electrode in glass systems to the chemical durability as shown in Figure 15, where Turner's data (Table IV) are converted to per cent of glass remaining and compared with potentials for glasses in the same composition range.

ACKNOWLEDGMENT

The authors wish to thank Mr. Tormod Forland and Professor Evelyn C. Marboe for valuable discussions and The Glass Research Laboratory of the Pittsburgh Plate Glass Company for its financial support of this work.

V. REFERENCES

1. T. Forland and M. Tashiro (in the preceding paper) The Glass Industry 37 381 (1956)
2. G. E. Rindone and W. A. Weyl, Jour. Amer. Cer. Soc 33, 91-95 (1950)
3. E. Plumat, Office of Naval Research Technical Report No. 60, Contract N6 onr Task Order 8, NR 032-264, The Pennsylvania State University, University Park, Pennsylvania, December 1954
4. F. Haber, Z. Elektrochem. *12*, 415 (1906)
5. P. Csaki and A. Dietzel, Glastech. Ber. *18*, 33 (1940)
6. W. A. Weyl, The Glass Industry *37* 264 (1956)
7. T. Forland, Office of Naval Research Technical Report No. 63, Contract N6 onr 269 Task Order 8, NR 032-264, The Pennsylvania State University, University Park, Pennsylvania, April 1955
8. Joseph von Fraunhofer, Gesammelte Schriffen, Edited by E. Lommel, Munchen 1888
9. V. Dimbleby and W. E. S. Turner, J. Soc. Glass Tech. *3*, 228 (1919)

• Dr. Robert F. Adamsky has been named senior engineer, Engineering Research Branch of The Carborundum Company, Niagara Falls, New York.

FMC CHEMICALS HAS NEW DEVELOPMENT MANAGER

Henry S. Winnicki, director of engineering and development of Food Machinery and Chemical Corporation's Chemical Divisions, has announced the appointment of Arthur S. Weygandt as manager of FMC Chemical central development department, with headquarters in N. Y.

Mr. Weygandt has had long service with the duPont organization, where among his various assignments he was technical director and a director of Duperial Argentina, a joint operation of duPont and Imperial Chemical Industries, and also spent several years with the technical division of the duPont foreign relations department. Mr. Weygandt has served as a security analyst for Continental Research Corporation and as an investment advisor for Rockland Corporation. He is a graduate of Case Institute of Technology, with a bachelor's degree in chemical engineering.

PEMCO ELECTS BRENTON VICE PRESIDENT

William V. Brenton has been elected a vice president of Pemco Corporation, Baltimore, according to an announcement by Richard H. Turk, chairman and president.

Mr. Brenton, who has been with Pemco since September 1945, has been serving as a district sales manager in the Mid-west. In his new position, Mr. Brenton's headquarters will be in Baltimore. He will direct field sales of the Company's porcelain enamel and ceramic divisions.

AMERICAN POTASH PROMOTES H. MAZZA

Harold Mazza has been appointed to the newly-established position of manager, research, at American Potash & Chemical Corporation's Los Angeles plant, according to an announcement by Joseph C. Schumacher, vice president in charge of research.

Mazza previously was assistant director of research at the company's main plant at Trona, California.

In his new position, Mazza will be in charge of research work on new process development and technical service at the Los Angeles facility.

INT'L MINERALS APPOINTS A. E. CASCINO

Anthony E. Cascino has been appointed to the newly created post of director of marketing for International Minerals & Chemical Corporation.

In establishing the new post and announcing the appointment of Mr. Cascino, Thomas M. Ware, International's administrative vice president, emphasized the importance of coordinating the marketing activity of each of the company's six product divisions. He said that Mr. Cascino's new responsibilities would be to effect such coordination in the areas of advertising, sales, merchandising and market research.

Mr. Cascino has published many articles in trade and business publications and recently collaborated on two books—"Marketing Channels in American Industry" and "Market Research Pays Off."

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FOOD MACHINERY AND CHEMICAL CORP. ELECTS OFFICERS

A. T. Loeffler

C. F. Prutton

Food Machinery and Chemical Corporation announced that at the annual organization meeting of its board of directors president Paul L. Davies was elected chairman and chief executive officer, and Ernest Hart, formerly executive vice president in charge of chemical divisions, was elected president. John D. Crummey, who has served as chairman of the board of directors since his retirement from active management in 1946, was elected honorary chairman.

At the same meeting the following executive promotions were made: Dr. Carl F. Prutton, vice president and technical director of chemical divisions, was elected executive vice president in charge of chemical divisons; James M. Hait, vice president, director of engineering, and manager of the Ordnance Division, was elected executive vice president; John D. Fennebresque, formerly vice president and assistant to the president, was elected executive vice president; Jack M. Pope, administrative vice president, was elected financial vice president; and Alfred T. Loeffler, staff executive of the chemical divisions, was elected a vice president.

Ben C. Carter, executive vice president in charge of machinery divisions, and all other corporation officers were re-elected with the exception of Dr. Max E. Bretschger, who retired on May 1.

APPOINTMENTS AT CORNING GLASS

Richard M. Smith has been appointed production superintendent of the Refractories Plant at Corning Glass Works, it was announced by R. Karl Smith, plant manager.

Mr. Smith succeeds George W. Rogers who has been named project engineer in charge of the special process development program handled by the Refractories Division development laboratories.

First associated with the ceramics laboratory of the Refractories Plant in 1950, Mr. Smith was appointed plant senior equipment and process engineer in 1954. For the past year he has been serving as plant supervisor of production and quality control.

Mr. Rogers first joined the Refractories Plant in 1933 as a kiln operator. He later served successively as a foreman of fabrication, assistant superintendent and, since 1944, as plant production manager.

NEW JOHN WILEY & SONS PUBLICATION

High Temperature Technology, edited by I. E. Campbell of the Battelle Memorial Institute, was published in March by John Wiley & Sons. Sponsored by The Electrochemical Society, the new book is the latest addition to Wiley's Electrochemical Society Series.

Thirty-five authorities combine here to summarize recent developments in the field, and to clarify the research of engineers, metallurgists, ceramists, and chemists working to develop new materials of construction for service at very high temperatures. In the first major section of the book—"Materials"—the authors cover metals, oxides, properties of carbon and graphite at high temperatures, carbides, borides, silicides, nitrides, sulfides, and cermets.

Part II—"Methods"—deals with sintering of metallic and nonmetallic refractory materials, means of achieving high temperatures and some of their limitations, resistance and induction-heated furnaces, arc furnaces, and other methods of achieving high temperatures. The last section —"Measurements"—includes temperature and its measurement, mechanical properties, physical properties, and special techniques. The book contains 526 pages and is priced at $15.00.

O-I PROMOTES J. W. HACKETT AND J. C. HAMILTON

J. W. Hackett

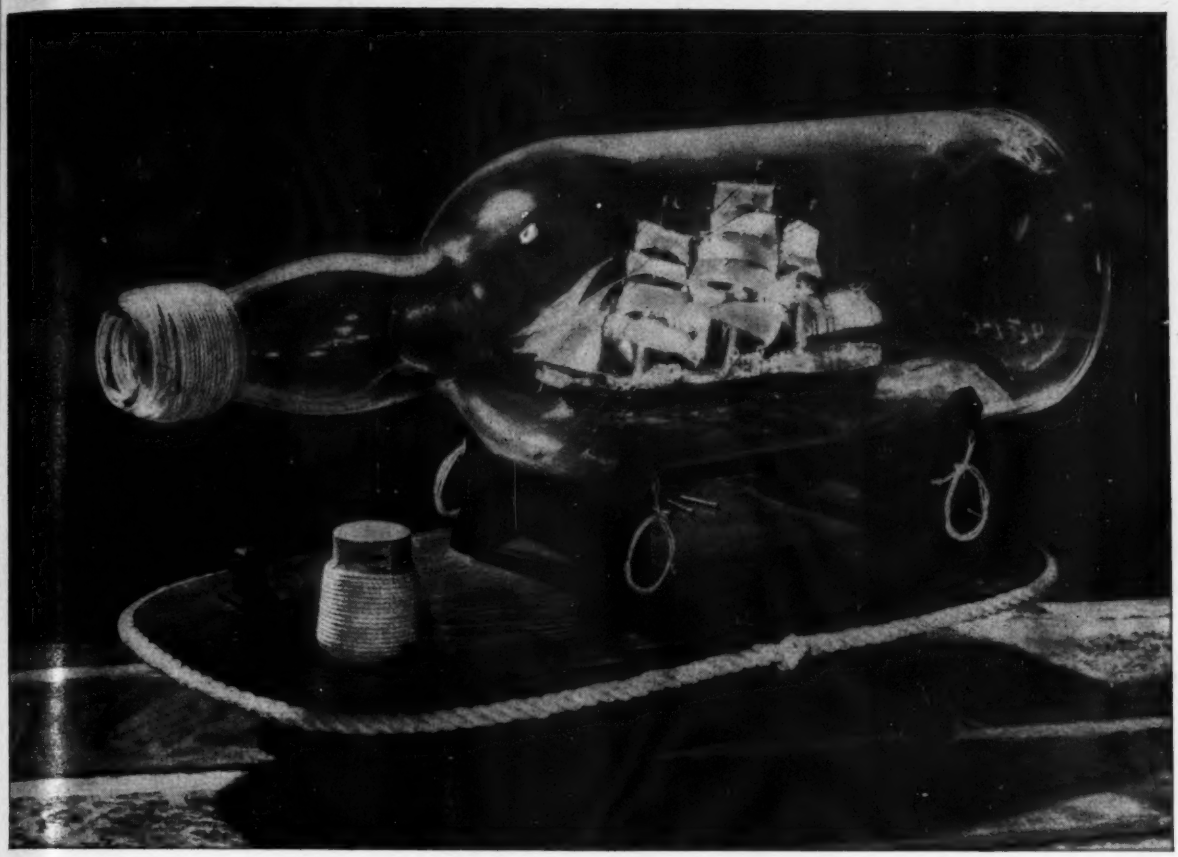
J. C. Hamilton

James W. Hackett has been promoted to director of engineering at the Owens-Illinois Technical Center, and Joseph C. Hamilton to director of research.

The announcement by Oscar G. Burch, vice president in charge of engineering and research, also transferred to the Administrative Engineering Department responsibility for certain development of new processes for making present products, formerly the work of the General Research Department.

Mr. Hackett, who has been director of research since 1953, will now be responsible for construction of new company facilities and major revisions to existing ones. He will also coordinate developmental work on new processes requested by the company's operating divisions and subsidiaries.

Mr. Hamilton, formerly assistant director of research, will be responsible for the program of general research on all materials of interest to O-I including not only glass, but plastics, metals and paper. In addition, he will direct research aimed at developing products not presently produced by O-I.



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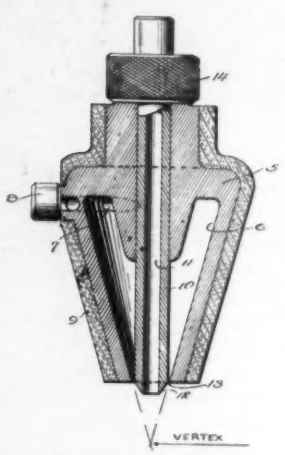
a second roller 45, which is immersed in a suitable bonding agent or medium 46, contained within a tank or receptacle 47. The treated mat passes out of the receptacle 47, over a roller 44 inches, then through a drying oven 50, mounted upon the frame 49.

Examples of suitable bonding agents or binders are various types of gums, asphaltic compounds, coal tar products, pitch, phenol formaldehyde resins, rubber, starch sugar, gelatin, polystyrene, methyl methacrylate or like products.

The impregnated sheet or mat 52 passes onto a second movable conveyor 53, which carries the impregnated sheet through the chamber 55 of the drying oven 50, so as to drive off or expel the solvent.

There were 35 claims and the following references cited in this patent: 2,357,392, Francis, Sept. 5, 1944; 2,392,882, Roberts, Jan. 15, 1946; 2,428,654, Collins, Oct. 7, 1947; 2,477,555, Roberts et al., July 26, 1949; 2,481,949, Richardson, Sept. 13, 1949; 2,528,091, Slayter, Oct. 31, 1959; 2,552,124, Tallman, May 8, 1951, and Fiberglass Standards Supplement #CP6.C1, April 8, 1949, published by the Owens-Corning Fiberglas Corporation, 1 page.

Making Glass Filaments. Fig. 5. Patent No. 2,722,718. Filed August 21, 1950. Issued November 8, 1955. Two sheets of drawings. Ralph G. H. Siu.



This invention relates to a method of making glass filaments, especially inherently curly glass filaments, by melt spraying.

Referring to Fig. 5, the nozzle comprises a generally frusto-conical body 5, having a hollow chamber 6, on the inside and having a gas inlet 7 at the larger end of said chamber, with a coupling 8, to couple a gas supply pipe (not shown) to the nozzle.

Due to the form of chamber 6 and the direction and location of the gas inlet, gas admitted under pressure to the chamber is forced to flow in a spiral path of ever-decreasing diameter, with consequent ever-increasing velocity. Arranged coaxially of the nozzle is a straight glass-feeding tube 10, having a smooth bore 11, of uniform diameter, and having its discharge end beveled as at 12 and projecting slightly beyond the discharge opening 13 in the nozzle.

As the molten glass flows out of the feed tube 10, by gravity or under pressure, it will meet a whirling conical blast of heated gas whose velocity constantly increases until it reaches supersonic velocity at the "vertex." The molten glass also reaches the "vertex" and is there disrupted, forming a multitude of curly filaments and under some conditions straight filaments which may be collected on a slowly moving belt (not shown), until a sufficient mass of the filaments has been collected, after which the mass may be removed for other processing.

An example of glasses used is as follows:

13.21 gm. K_2CO_3 (anhydrous)
28.22 gm. Na_2CO_3 (anhydrous powder)
4.92 gm. Li_2CO_3 (corresponding to 2.00 gm. Li_2O)
23.00 gm. Al_2O_3 (anhydrous)
11.98 gm. H_3BO_3
4.0 gm. ZnO
65.78 gm. 85 per cent phosphoric acid (corresponding to 62.82 gm. 89 per cent H_3PO_4)

There were 5 claims and 10 references listed.

NOMINATIONS BEING RECEIVED FOR SECOND A. C. S. GLASS AWARD

Frank R. Bacon, chairman of the Northwestern Ohio Section of The American Ceramic Society announced that nominations are now being accepted for the Second Toledo Glass and Ceramic Award.

Any member of The American Ceramic Society or of the Northwestern Ohio Section may make a nomination which will remain active for three years. The nomination must be made in writing and should include a statement of the candidate's career and achievements in the ceramic field that make him worthy of consideration for the Award.

Nominations should be sent to Mr. James C. Coleman, Owens-Illinois Technical Center, 1700 North Westwood Avenue, Toledo 1, Ohio, chairman of the Award Committee. The other members of the Committee are: A. E. Badger, Libbey-Owens-Ford Glass Company; F. L. Bishop, Owens-Illinois Glass Co.; K. C. Carnes, Toledo Engineering Co.; L. V. Gagin, Libbey-Owens, Ford Glass Fibers Co.; J. F. Chambers, National Gypsum Co.; and L. G. Ghering, Preston Laboratories.

Nominations for the Second Award, which will be presented sometime in the Spring of 1957, will close September 1, 1956.

Mr. Bacon stated that the Award was established to accord recognition for an outstanding scientific or engineering achievement in the glass and other ceramic industries, but it is not necessarily limited to such achievements. There are no requirements as to time, place, duration or type of work or contribution which the recipient must meet.

Francis C. Flint, technical director of the Hazel-Atlas Glass Co. was the recipient of the First Toledo Glass and Ceramic Award.

H. A. FOX PROMOTED AT L. O. F. GLASS FIBERS

Herbert A. Fox, formerly technical manager of the L.O.F. Glass Fibers Company plant in Parkersburg, W. Va., has been promoted to director of the Future Planning Division of the company.

According to the announcement by R. H. Barnard, president and general manager, Mr. Fox will headquarter at the new Research Center in Waterville, Ohio.

He was technical manager of the Parkersburg plant of Libbey-Owens-Ford's Fiber Glass Division before its merger in 1955 with Glass Fibers Inc.

Before that he was associated with Owens-Corning Fiberglas Corporation for eight years and was assigned in 1951 as project manager at Parkersburg under the licensing contract between Libbey-Owens-Ford and Owens-Corning.

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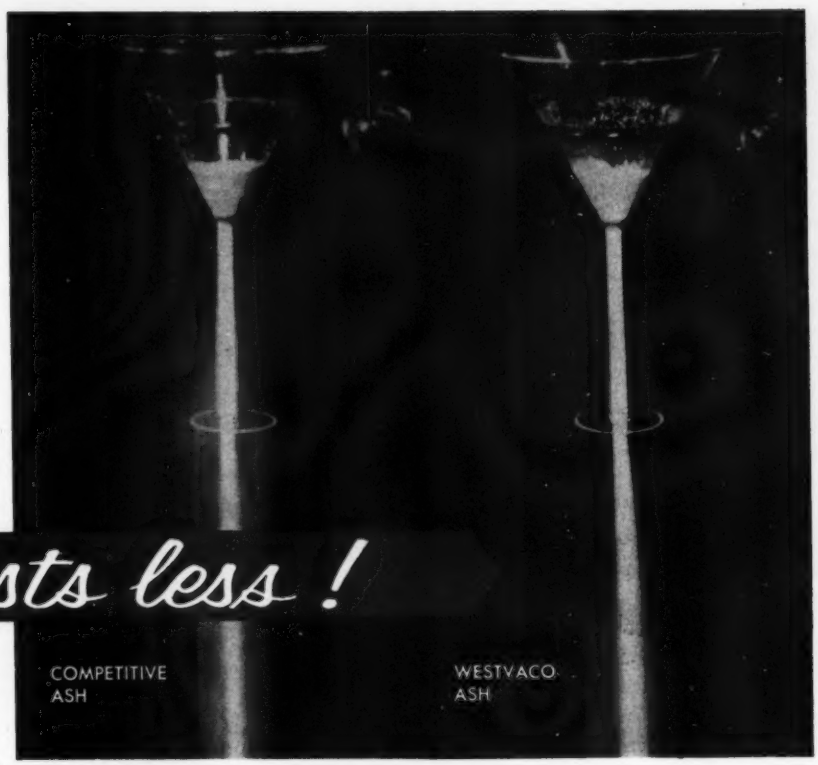

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REORGANIZATION RESULTING FROM PACIFIC COAST BORAX & U.S. POTASH MERGER

J. M. Gerstley, president of United States Borax & Chemical Corporation, has announced that, at a board of directors meeting held in New York July 10th, decisions were reached with respect to the organization of the new company which resulted from the merger of the former United States Potash Company into the former Pacific Coast Borax Company.

The administrative office of the new corporation will be located in Los Angeles in the company's own office building, 630 Shatto Place. Mr. P. J. O'Brien will be the vice president and general manager of the new company with Los Angeles as his headquarters.

The following four operating divisions have been created: The Pacific Coast Borax Company Division, which will carry on borax manufacturing and sales in the industrial field under the leadership of Mr. J. F. Corkill, who has been appointed vice president and general manager of this division; The United States Potash Company Division which will be responsible for the production and sale of potash under Mr. Dean R. Gidney, who has been appointed vice president and general manager; The 20 Mule Team Products Division, which will handle the sales and advertising of household products, including industrial soaps and soap dispensers, manufactured by the new company. Mr. D. V. Parker has been appointed vice president of this division.

The research activities of the new company have also been organized under a separate division of which Mr. G. A. Connell will be vice president and Dr. D. S. Taylor, director.

For the time being, the head office of the Pacific Coast Borax Company Division will remain at 100 Park Avenue, New York and that of the United States Potash Company Division at 30 Rockefeller Plaza, New York. It is planned to locate these divisions together in new premises in New York when suitable arrangements can be effected. The principal office of the 20 Mule Team Products Division will be located in Los Angeles in the company's building and the principal office of the Research Division will be similarly located for the present.

The directors also authorized the construction of a Research Center for the company on a five-acre tract of land recently acquired in the vicinity of Anaheim, California. This is expected to cost, fully equipped, approximately one million dollars and to be ready for occupancy around March, 1957. Thereafter the principal activities of the Research Division will be directed from the new Research Center.

In addition to the above appointments, Mr. H. M. Albright, formerly president of the United States Potash Company, has been made a special consultant to the new company. Mr. Paul Speer was elected vice president and legal advisor and Mr. N. C. Pearson, vice president in charge of Borax sales in overseas markets. Mr. R. F. Steel was elected secretary & treasurer; Messrs. W. F. Dingley and W. A. Ackerman were appointed assistant secretaries and Mr. R. C. Dosta was appointed assistant treasurer of the new corporation.

• Paul A. Harmon has been appointed traffic manager at the Laclede-Christy Company, Division of H. K. Porter Company, Inc.

T. H. HUBER APPOINTED MANAGER O-I CUBA PLANT

Appointment of Thomas M. Huber as manager of Owens-Illinois Glass Company's new glass container plant at San Jose de las Lajas, near Havana, Cuba, has been announced by John L. Gushman, O-I vice president and general manager of the International Division.

Mr. Huber, with the company since 1946, will move to Cuba from the company's Alton, Ill., plant where he has been Quality & Specification Department supervisor since 1953.

Scheduled for completion in the latter part of 1957, the Cuban plant will be the first O-I manufacturing installation outside the United States. It will be capable of producing about 72 million bottles and drinking glasses per year, from three glass melting furnaces.

The principal products will be glass containers for the packaging of foods, beverages, and drugs. At the outset, the plant will employ about 200, all Cubans except for a few essential experienced technicians to be drawn from Owens-Illinois' production staff in the U. S.

Ground-breaking ceremonies, attended by President Fulgencio Batista of Cuba, were held June 15.

F. T. RITTER PROMOTED AT KIMBLE GLASS

Frank T. Ritter, Jr., has been appointed head of the Product Development Department of the Blown and Tubular Division of Kimble Glass Company, subsidiary of Owens-Illinois Glass Company.

The Department is newly formed and will aid the Division in expanding sales of present tubing, scientific glassware and tubing-made glass container lines. Mr. Ritter will be responsible for the development of new products and re-evaluation of existing products.

Born in Philadelphia, Pa., Mr. Ritter is a graduate of the United States Naval Academy, but was a Colonel in the U. S. Army in World War II. He joined Kimble at the Vineland, N. J., plant in 1935 and held various maintenance, engineering, manufacturing and production positions. In 1947 he was appointed plant manager at Warsaw, Ind. Late that year, Mr. Ritter was transferred to Toledo to handle special assignments in the General Manufacturing Department, a position he held until his recent appointment.

• Norway has eased import restrictions from dollar areas but Norway is also planning to step up exports of glass products to the Canadian market.

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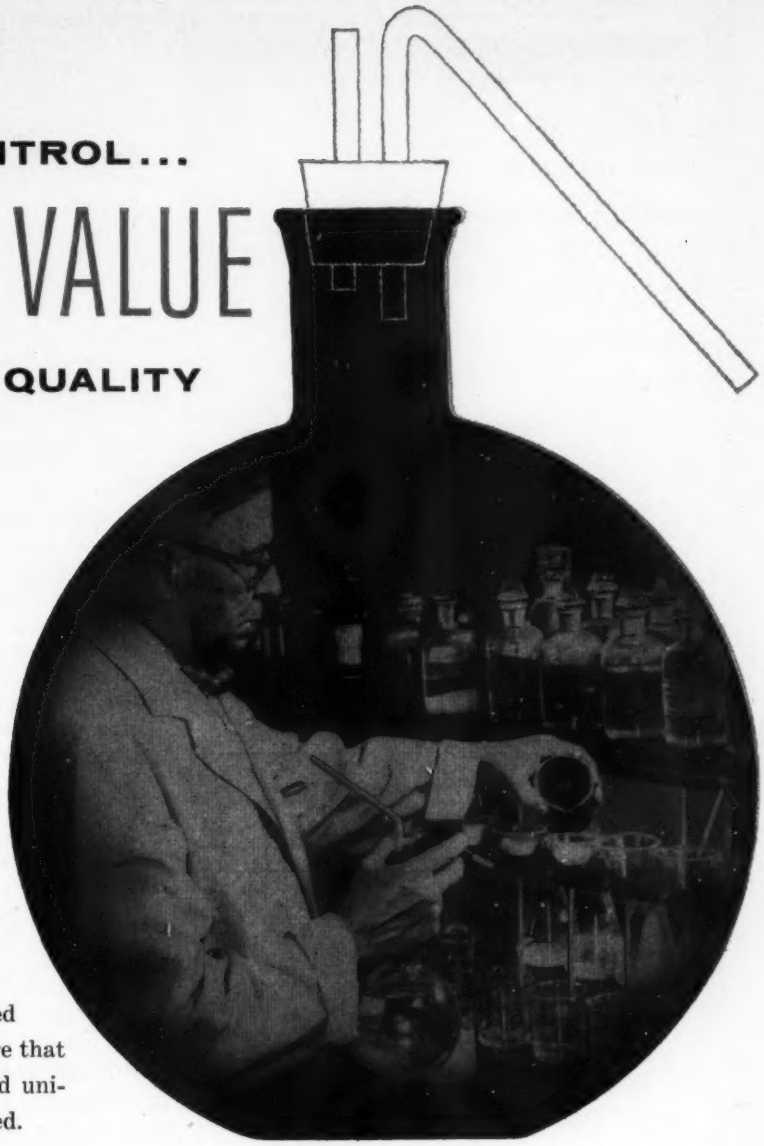

Indispensable in color production at Drakenfeld is the full-time application of analytical chemistry. To guard against contaminants that can affect color quality, Drakenfeld chemists have at their command the most modern scientific laboratory equipment. Raw materials are tested on arrival and in process to assure that our high standards of purity and uniformity are constantly maintained.

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PITTSBURGH PLATE ANNOUNCES GLASS RESEARCH APPOINTMENTS

Pittsburgh Plate Glass Company has announced a series of top administrative appointments for its glass division research laboratories at Creighton, Pennsylvania, according to R. B. Tucker, vice president.

Dr. S. Frank Cox has been appointed director emeritus and technical consultant following 13 years of service as director of research.

He became associated with Pittsburgh Plate's control development laboratory in 1937, and since has also served as director of technical sales for Pittsburgh Corning Corporation and technical director of Pittsburgh Plate's double-glazing division.

Dr. James E. Archer, formerly associate director of research, has been named director of research succeeding Dr. Cox. He joined Pittsburgh Plate's glass division research in 1952 as assistant director of research.

E. Lester Fix, has been appointed manager of plant processes section in addition to his present position as associate director of research. He joined Pittsburgh Plate in 1928 and has since been associated with the glass division's research operations.

Brook J. Dennison has been named associate manager of plant processes section while also continuing in his present capacity as assistant director of research. He started with Pittsburgh Plate's glass division research as a chemist, later served as head of the chemical department.

Dr. George S. Bachman, formerly director of research, fiber glass division, has been appointed assistant director of research and manager of fiber glass processes section. Dr. Bachman has been associated with Pittsburgh Plate since 1947.

William F. Galey, formerly head of applied science section, basic research, has been named manager of process engineering section. He joined the company as a lab assistant in 1942 and also has served as technical assistant and technician in basic research.

DR. WILLIAM S. RODNEY GIVEN AWARD

Dr. William S. Rodney, a physicist in the Optical Instruments Section of the National Bureau of Standards, has been awarded a Guggenheim Fellowship.

The award, which was based on Dr. Rodney's work in fundamental refractometry of transparent crystals, will enable him to spend a year doing advanced work at the Institute for Optical Research in Stockholm, Sweden. His field of study will be in the application of phase contrast methods.

Dr. Rodney, who joined the NBS staff in 1949, is the author of a number of papers in his field. He is a member of Sigma Xi and the Optical Society of America.

FMC FOREIGN CHEMICALS DEVELOPMENT MANAGER

William D. Morrison was appointed to the new post of manager, foreign chemical development, according to an announcement by Henry S. Winnicki, director of engineering and development of Food Machinery and Chemical Corporation's Chemical Division.

Mr. Morrison will be responsible for new commercial opportunities abroad; he will headquarter at the chemical division's administrative offices in New York.

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of interest to—

SALES

CONTROL

RESEARCH

MANUFACTURING

A COLOR-SOUND MOTION PICTURE
to help sell your products!
AVAILABLE TO YOU AT NO COST

SUBJECT: *Ceramic Coating Materials*

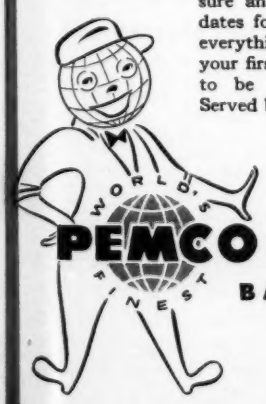
Pemco has just released a feature-length motion picture for use by companies using porcelain enamel finishes, glaze finishes and other ceramic coatings. The 16 mm color-sound movie tells how frits for glazes, porcelain enamel and other ceramic materials are made and gives viewer background information on the inherent advantages of such finishes.

The film is of interest to Management, Sales, Production, Research, Design and Advertising men or to any other executive concerned with the manufacture and sale of products using these lifetime finishes.

"Everything Under Control" is ideal to fill out your program at meetings of Management, Foremen's Groups, Production Supervisors in an instructive and entertaining manner. It's also excellent for showing to college classes and sectional meetings within the Ceramic Industry.

RESERVE A PRINT FOR YOUR SHOWING NOW!

Naturally, we do not have sufficient prints of this film to meet everyone's needs at the same time, so please be sure and give us *three* alternate dates for your showing. We'll do everything in our power to meet your first choice, but this will have to be on a First Come—First Served basis.



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GLASS FEATURED IN DIAMOND ALKALI'S NATIONAL ADVERTISING

Some of our customers are very enthusiastic!

Watch his face light up when his favorite food comes in gleaming glass! When he can see what's coming, his appetite gets itself all ready.

And watch his mother's eyes rove the grocery shelves for anything that makes his mealtime easier. She prefers glass for so many reasons. For instance, she can store unused portions right in the jar . . . no waste at all. She can see at a glance what's inside . . . and how much.

Since this youngster will consume hundreds of jars of baby food before he graduates to steak and French fries, he is an important customer of ours. Because essential to making glass is soda ash, one of the most important of Diamond Alkali's "Chemicals you live by."

Diamond Alkali Company, 300 Union Commerce Building, Cleveland 15, Ohio.

Diamond Chemicals

One of the finest examples of product-support or industry-boosting advertisements beamed to the consuming public we've seen, is one that came across our desk at presstime. It caught our eye and captured our attention and interest for a number of reasons, the biggest one, perhaps, being that it deals with one of the subjects closest to our hearts—glass.

Published by Diamond Alkali Company, Cleveland, Ohio, the ad is scheduled to appear in two national news magazines during August where it will be exposed to some three million consumers across America.

Subject of the four-color, full-page ad is *glass packaged* baby foods. Entitled, "Some of our customers are very enthusiastic!" it features a chubby cherub in his high-chair at mealtime "caught by the camera" in the act of eating a strained green vegetable.

"Watch his face light up when his favorite food comes in gleaming glass!" the copy points out. It continues: "When he can see what's coming, his appetite gets itself all ready.

"And watch his mother's eyes rove the grocery shelves for anything that makes his mealtime easier. She prefers glass for *so* many reasons. For instance, she can store unused portions right in the jar . . . no waste at all. She can see at a glance what's inside . . . and how much.

"Since this youngster will consume hundreds of jars of baby food before he graduates to steak and French fries, he is an important customer of ours. Because essential to making glass is soda ash, one of the most important of Diamond Alkali's "Chemicals you live by!"

Concise, to the point, yet hard-hitting, the copy loses no time in creating a favorable impression for glass packed foods, for glass as a container, and for Diamond as a glass industry supplier. The ad may not sell a nickel's worth more of soda ash for Diamond, but should prove invaluable as a goodwill-builder for the company.

Production of jars for packaging baby foods has increased by leaps and bounds in recent years and has become an increasingly important factor in the glass industry's continuing growth. Much of this progress is due to aggressive promotion and alert merchandising by food manufacturers, other glass packers and, of course, the glass container industry itself; but the ever-widening public acceptance of and reliance upon glass as a dependable packaging material also can be attributed in part to the support of companies such as Diamond Alkali and other suppliers to the glass industry.

THREE NEW PLANTS ANNOUNCED BY INT'L MINERAL & CHEM. CORP.

International Minerals & Chemical Corporation has recently started up three new plants in the corporation's Industrial Minerals Division, according to Louis Ware, president. The plants are located in Ontario, Tennessee and California.

The Ontario plant, northeast of Toronto at Blue Mountain is a one and one-half million dollar mine and plant and produces nepheline syenite with a capacity of approximately 100,000 tons per year.

The plant at Tennessee is located at Greeneville and is a mica benefication plant. The plant cost about one-half million dollars and has a capacity of approximately 64 tons per day.

The third plant is located in Los Angeles, California and recently opened its first perlite grinding unit for specialty markets. New plans now provide for doubling the size of this plant which, operating under a patented process, yields perlite in an unusual form not previously available.

TWO PROMOTIONS AT L. O. F.

Gerald Lantz has been named plant buyer and Ralph W. Enoch has been appointed stores keeper at the Parkersburg plant of L.O.F. Glass Fibers Company, it was announced by John M. Keenan, plant manager.

Mr. Lantz and Mr. Enoch will assume the duties and responsibilities of Joseph P. Atkinson who has been promoted to general purchasing agent for the company in Toledo.

Mr. Lantz had been senior clerk in the Stores Department and Mr. Enoch assistant stores manager.

PROMOTIONS AT L-O-F OTTAWA PLANT

John D. Hemley was recently named new superintendent of the Safety Glass Laminating plant of Libbey-Owens-Ford Glass Company at Ottawa, Illinois.

Albert N. Guthrie was named the new plant production manager of the Ottawa factory and Lucien C. Strow became the new plant engineer.

• Establishment of a Connecticut sales office in Hartford for the Glass Container Division, Owens-Illinois Glass Co., has been announced by Sidney F. Davis, vice president and division general sales manager. John H. Kessler is senior salesman in the new office, assisted by James D. Irwin, Mr. Davis said. Both men moved from the company's New York branch.

OPEN FOR BUSINESS

New refractories plant at Columbiana, Ohio to give better-than-ever service to the glass industry!

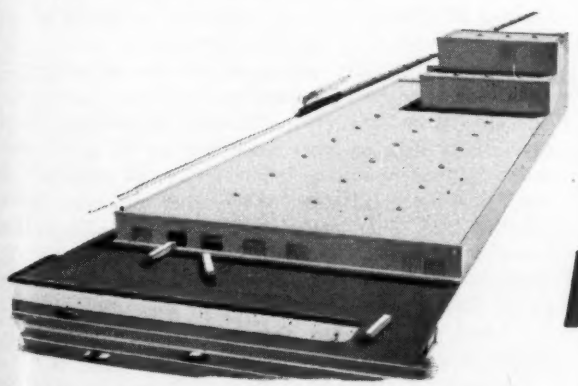
THE NEW Kaiser Chemicals refractory plant at Columbiana, Ohio has now begun production of glass furnace refractories.

Located on a 100 acre site adjacent to the main line of the Pennsylvania Railroad and the Ohio-Pennsylvania Turnpike, the new Columbiana plant assures rapid rail and truck transportation to glass producers in the Midwest and East.

Already serving the nation's glass industry from three plants in California, this new *Kaiser Chemicals* facility means new production to meet the increasingly heavy demand for Kaiser refractories. The new Columbiana plant will manufacture basic checker brick of the Periclase D and Periclase A types, as well as Chrome Periclase brick for regenerator superstructures.

These refractories are especially designed for peak performance in specific applications in glass furnaces. In fact, for more than 12 years, Kaiser Periclase Brick have *set the standard* of performance for the industry. *That is why more and more glass producers regard them as the most dependable refractories available today!*

If you have a refractory problem in your continuous glass furnace regenerators which might be solved by the *prompt delivery* of *superior quality, dependable refractories,* why not get in touch with us?



For more information call our nearest Sales Office: Kaiser Chemicals Division, 1924 Broadway, OAKLAND 12, Calif. ... 3 Gateway Center, PITTSBURGH 22, Pa.... 518 Calumet Bldg., 5231 Hohman Avenue, HAMMOND, Indiana.

To obtain free copies of Kaiser Chemicals products literature write Kaiser Aluminum & Chemical Sales Inc., 1924 Broadway, OAKLAND 12, California, Dept. G6912.

Kaiser Chemicals

Pioneers in Modern Basic Refractories

REFRACTORY BRICK & RAMMING MATERIALS • CASTABLES & MORTARS • MAGNESITE • PERICLASE • DEADBURNED DOLOMITE • ALUMINAS

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the original 90% Optical Grade Cerium Oxide.
Also available in mirror grade.

TO COLOR AND DECOLORIZE GLASS

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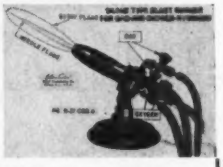

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President

Aplite

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Telephone 2411

Pioneer Producers of APLITE

Minor Constituents in Glass . . .

(*Continued from page* 436)

glasses. The shade obtained is somewhat dependent on the oxidation state of the glass.

The yellow and red glasses represent an interesting series. As commonly melted these glasses contain various combinations of cadmium oxide, cadmium sulfide, sulfur, selenium, and tellurium. The colors formed in glasses of this type are colloidal and therefore require heat treatment to develop them. The actual colloidal particles formed are possibly solid solutions of cadmium sulfide and cadmium selenide or telluride. The yellow glasses are primarily the cadmium sulfide type. The shade can be varied by additions of selenium or tellurium. The red members of the series employ cadmium sulfide and amounts of selenium to get the proper shade. When properly heat treated, the reds and yellows have very sharp color or transmission cut-offs.

Since the colors are colloidal the exact shade obtained from a given composition can be altered by changes in the heat treatment cycle. This makes it possible to compensate for slight compositional variations. It also makes it possible to get several shades from the same composition.

In order to obtain the same composition over a period of time very close control must be maintained on temperatures, state of oxidation of the glass, and melting time. The materials used all seem to be both volatile and also sensitive to state of oxidation.

Yellow glasses can also be made using uranium for the colorant. This glass will fluoresce green when illuminated by ultraviolet and blue light. Uranium has also been used to give warmer tone to some of the opal glasses.

Ruby glasses can also be made by using gold salts for the coloring material.

Black glasses can be made from a variety of colors simply by using very high concentrations. Materials can also be selected so as to produce glasses which will transmit either ultraviolet or infrared radiation and black out the visible. As mentioned earlier, cobalt and nickel will transmit the near ultraviolet, and combinations as chromium, vanadium, and manganese will transmit infrared.

Glasses may also be made to absorb infrared radiation by employing ferrous oxide and a reducing agent. These glasses have a blue-green color.

In general, more brilliant colors are produced in the softer glasses than in hard borosilicates.

Many commercially melted glasses have an objectionable color when used for tumblers, tableware, containers, and other items. This color is usually the result of small amounts of iron or other impurities in the glass. One source of this iron is the impurities in raw materials as sand, limestone, and many of the other minerals. Cullet crushing and other material and batch handling also contribute their share of iron. The most obvious way to decolorize the glass is, of course, to eliminate as much of the iron as possible. This means the purchasing of lower iron grades of raw materials, better housekeeping, magnetic separation of cullet and batch, etc.

The color remaining from the residual iron can then be made less objectionable by oxidizing the glass to produce a yellow-green rather than blue-green color. The oxi-

(*Continued on page* 470)

use these

Harbison-Walker Refractories

with confidence

their use in vulnerable positions in the super-structure of glass tank furnaces saves maintenance costs and extends operating campaigns

H-W CORUNDUM is an extremely hard fired refractory consisting entirely of corundum (99+% crystalline alumina). Its properties of particular importance for use under the most severe operating conditions are high refractoriness, substantially equivalent to that of pure alumina (3700°F.), exceptional volume stability and resistance to fluxing by alkalies at high temperatures.

KORUNDAL brick is a 90% alumina refractory having a homogeneous mineral composition of corundum bonded with mullite. It is used in standard sizes and special shapes with great benefit under conditions of thermal shock, soaking heat and severe fluxing conditions at very high temperatures.

H-W MULLITE is made synthetically rather than from the natural minerals of appreciably lower alumina content. Its alumina content closely corresponds to that of pure mullite. Because of its high degree of stability and its fully developed mineral composition, H-W MULLITE is unusually resistant to fluxing by corrosive dust and volatile alkalies. In addition, the superior physical properties contribute to the excellent service secured from this unusual synthetic mullite refractory.

Harbison-Walker Technical Service is freely offered to help in the selection of the brands of refractories best suited for your needs.

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Minor Constituents in Glass . . .
(*Continued from page* 668)
dation can be accomplished by arsenic, antimony, or cerium oxides in combination with a nitrate. An oxidizing furnace atmosphere is also very helpful.

Further decolorization is possible by adding a complementary color to mask the yellow-green iron color. Commonly employed decolorizers include selenium and cobalt, manganese and cobalt, and in potash glasses, nickel oxide. Glasses decolorized with manganese have a tendency to become purple after extended exposure to sunlight. Decolorization by adding complementary colors actually reduces the transmission of the glass by producing a neutral gray color.

Some optical and other glasses requiring very high transmission prohibit the use of complementary colors and therefore demand low iron materials and oxidation.

ORGANIZATION CHANGES AT AMERICAN POTASH

Peter Colefax, president of American Potash & Chemical Corporation, announced recently that Daniel S. Dinsmoor has been named vice president in charge of planning and development for the company, and Joseph C. Schumacher has been elevated to vice president in charge of research.

Mr. Dinsmoor previously was vice president in charge of research and development.

NEW AMERICAN POTASH & CHEMICAL TRADEMARK

The American Potash & Chemical Corporation has adopted a new streamlined trademark for its complete line of Trona tradenamed products. The newly-designed trademark (top) is displayed with the former trademark (lower) by William J. F. Francis, vice president in charge of Sales for the chemical company.

THE CANADIAN GLASS MARKET

Canadian Government reports imports from United States included the following in the first quarter of 1956:

Decanters and tumblers, $116,972; Glass plates for optical manufactures, $113,032; Glass carboys bottles jars, $1,327,673; Glass tableware cut glass NOP, $363,632; Lamp bulbs and tubings for, $718,777; Glass shades or globes, $43,634; Lenses glass NOP, $52,536; Fresnel type lenses globes, $29,609; Moulded shapes for electric fixtures, $385,348; Heat resisting glassware, $994,901; Sheet glass over 34 oz. sq. ft., $151,846; Plate glass not over 7 sq. ft., $59,256; Plate glass 7 to 25 sq. ft., $228,532; Plate glass NOP, $1,656,713; Laminated glass sheets, $5,178; Glass sheets wired, $4,002; Ornamental colored glass, $21,055; Painted obscured white glass, $89,619; Stained or ornamental windows, $1,273; Mirrors of glass framed or not, $146,139; Glass balls for fibers or yarn, $68,153; Glass to be cut or mounted, $62,157; Glass blanks for reflectors, $105,030; Beads for manufacturers' imitation pearls, $13,406; Photographic dry plates, $47,152; Spectacles eye glass lenses, $245,299; Manufacturers of glass NOP, $556,751; Glass wool or fiber glass, $286,693; Glass blocks, $105,042.

Wholesale prices of window glass stood at 270.2 in May this year in contrast to 257.0 a year ago in same period and plate glass at 201.5 as against 189.3 last year, based on 1935-39 being 100, according to latest survey by Canadian Government.

Thermos Bottle Co., Ltd., granted supplementary letters patent by the Secretary of State of Canada changing the corporate name of the company to Canadian Thermos Products Ltd.

FMC CHEMICALS RESEARCH STAFF

Dr. Emil Ott, vice president and director of chemical research of Food Machinery and Chemical Corporation's Chemical Divisions announces three central research staff appointments for the new facilities under construction near Princeton, New Jersy.

Dr. O. C. Karkalits becomes process and economic appraisal supervisor. John E. Zrembo becomes supervisor of general analytical services, and John P. Alden is named technical information service supervisor.

WYANDOTTE NAMES J. W. ZABOR

Dr. J. William Zabor has been named director of research for Wyandotte Chemicals Corporation, according to an announcement by Frank B. Wolcott, vice president and general manager of the firm's Research and Engineering division.

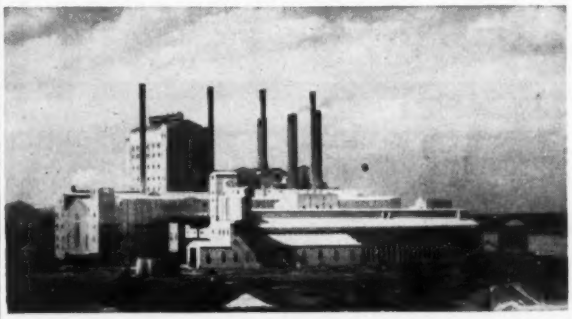
Dr. Zabor joins Wyandotte from the Pittsburgh Coke and Chemical Company where for eleven years he successively held the positions of director of research, Activated Carbon Division; director of research and development for the company; and assistant to the vice president, Chemicals Division.

• Dr. Norbert J. Kreidl, Chemical Research Director, attended the Fourth International Congress on Glass in Paris, July 1-7, where he was chairman of the session on Radiations. With Dr. J. R. Hensler, he presented a paper on gamma radiation effects on multicomponent glasses. A Russian delegation participated for the first time since the establishment of the Congress in 1933.

Milestones in Glass Progress

PHOTO COURTESY THE TOLEDO MUSEUM OF ART

1680 Crystal, or flint glass, is the best known of all British glassware. Introduced in England in 1675, it was the result of the efforts of George Ravenscroft, and Seignior De Costa—an Italian glassmaker brought to London fifteen years before. Crystal bowl, above, was produced about 1680.



1890 Michigan Alkali Company, now a division of Wyandotte Chemicals Corporation, was founded by Captain J. B. Ford to supply Soda Ash to the glass industry; part of Wyandotte's modern Soda Ash facilities is shown above. Wyandotte has literally grown up with glass. Today, as in the past, it is a working partner, supplying technical assistance and raw-material chemicals to those great companies marking milestones in glass progress.

Wyandotte CHEMICALS

Michigan Alkali Division, Wyandotte Chemicals Corporation
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Founded by a Glassmaker to Serve the Glass Industry

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Desirable opportunity in
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Experienced in glass manufacture, preferably glass to metal sealing.

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OPPORTUNITY

Can you set up and supervise a glass blowing shop to construct and repair glass equipment for an expanding research and development department?

Can you fabricate intricate laboratory apparatus and direct the efforts of others?

Such an opportunity exists in Niagara Falls, New York with a nationally established chemical corporation.

Send résumé to Box 192, c/o The Glass Industry, 55 West 42 Street, New York 36, New York.

HARRY O. SCOTT—CONSULTANT

Operation all types of glass, sheet, rolled, pressed, blown and bending all colors.

Box 812, Point Marion, Pa.
Phone RA 5-9324

HELP WANTED MALE—Quality Control Assistant for Glass Container Manufacturer. Engineering degree desirable but not essential. Some travelling. Submit full resume, including salary requested, experience and education. Write Box 190 c/o THE GLASS INDUSTRY, 55 West 42 St., New York 36, N. Y.

MACHINERY WANTED

WANTED: One J. P. S. Lynch Machine in good condition. Would also buy spare parts. Reply to Box 191, c/o THE GLASS INDUSTRY, 55 West 42 St., New York 36, N. Y.

Research Digest

(*Continued from page* 450)

of the molecule, the theory of nonpenetration and inability to remove hygroscopic water would predict a slight effect on strength. It is difficult, however, to associate these factors with a net loss in strength compared with breakage in air. It is suspected that the relatively high dipole moment and the strong electron-attracting character of the nitro group are of significance in the observed detrimental effect on strength.

R. P. STARK WINS O. HOMMEL SCHOLASTIC AWARD SECOND TIME

Two-time scholarship winner Ronald P. Stark of Pleasant Mount, Pa., is spending his second summer gaining practical knowledge by working in the same field for which he is studying—ceramics.

For his scholastic achievement and leadership, Ronald was awarded the Oscar Hommel Memorial Scholarship at Pennsylvania State University for the school year 1954-55, the first for such an award. He repeated again in the school term 1955-56. The winner is selected by the Dean of the College of Mineral Industries upon recommendation of the College Scholarship Committee and the Head of the Department of Ceramics, in which department Ronald is studying to become a ceramic engineer.

For the second straight summer Ronald is working in the Color Laboratory of The O. Hommel Company, sponsor of the scholarship, where he is gaining practical knowledge and experience in the weighing and blending of pottery colors for matching and for production control.

Ronald was born in Carbondale, Pa., and is a 1954 graduate of Pleasant Mount Vocational School. He is a member of the Newman Club, American Ceramic Society, and the National Institute of Ceramic Engineers.

Scholarship winner, Ronald P. Stark, receiving instructions from Paul Henry, head of Color Laboratory, The O. Hommel Company.

• Dr. Joseph Rood has joined the Chemical Research Laboratory of Bausch & Lomb Optical Co. as head of the Glass Physics Section. Dr. Rood was formerly Associate Professor of Physics at the University of San Francisco.

Woven Wire Feeder Belts . . .

(*Continued from page* 445)

even in cases where this type of preventive maintenance is not carried out, worn portions of the woven wire feeder belt can be easily removed and replaced with new belting, thus appreciably reducing replacement cost.

Metal Selection

Since very little corrosion is encountered, most glass plants are now using plain carbon steel with excellent results. However, a number of concerns have experimented with the use of aluminum woven wire feeder belts and have found that unannealed ware conveyed on aluminum belts is almost completely free from certain types of checks. In one comparative test, for example, a steel belt and an aluminum belt were installed on identical feeder lines. After two months of operation, records on checking indicated that the bottles carried by the aluminum belt averaged only 5¼ checks per bottle against 10 per bottle for the steel belt. At the same time, it was reported that the checks from the aluminum were not as large or as deep as those from the steel belt. However, another result of the same test was that 32¼ inches had been removed from the aluminum belting due to stretch while only about 24 inches had been removed from the steel belting for the same reason. Thus, this is by no means a final endorsement of aluminum woven wire feeder belts as being superior to steel since further investigations remain to be made.

Along these lines, though, some manufacturers have tested belts woven from aluminum coated steel wire as a compromise material. This type of wire combines the advantage of reduced checking due to the aluminum coating with the tensile strength and stretch resistance of the underlying steel to produce what appears to be an excellent compromise material. In instances, the test belts have proved so successful that some glass manufacturers have standardized on the aluminum coated steel wire for the feeder belt lines where checking is a problem.

As we have discussed, there are many reasons why woven wire belting offers advantages over other belting on feeder lines. However, again as is the case with wire belts for lehr use, it is not simply a matter of specifying "one (1) woven wire feeder belt, x feet by x inches". Specific selection should be made only after a careful examination of the operating conditions involved and, most important, with the cooperation and advice of an experienced wire belt engineer.

AMERICAN WINDOW GLASS APPOINTS FOUR

The superintendents of four American Window Glass Company operations have been appointed to the positions of plant manager, according to H. Dean Menoher, vice president—manufacturing.

The new positions will be filled by E. C. Good at Plant 1 in Arnold, Pa.; James M. Staples at Plant 2 in Jeannette, Pa.; Pete Magrini, Sr., at Plant 3 in Okmulgee, Oklahoma; and Frederick W. Hassett at Glass Products, Incorporated, the company's Ellwood City subsidiary.

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